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.... No. 54.

FOURTH ANNUAL REPORT

OF THE

MASSACHUSETTS
HIGHWAY COMMISSION.

JANUARY, 1897.

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Commonwealth of Massachusetts.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled.

The undersigned, commissioners appointed under the provisions of chapter 476 of the Acts of 1893, entitled “An act to provide for the appointment of a Highway Commission to improve the public roads, and to define its powers and duties,” herewith submit their fourth annual report.

THOMAS C. MENDENHALL.
NATHANIEL S. SHALER.
WILLIAM E. McCLINTOCK.

BOSTON, MASS., Jan. 6, 1897.

LIST OF OFFICERS OF THE MASSACHUSETTS
HIGHWAY COMMISSION.

THOMAS CORWIN MENDENHALL,
NATHANIEL SOUTHGATE SHALER, } *Commissioners.*
WILLIAM EDWARD MCCLINTOCK,

CHARLES MILLS, Chief Engineer.

AUSTIN BRADSTREET FLETCHER,	<i>Clerk.</i>
JOHN MICHAEL McCARTHY,	<i>Assistant Clerk.</i>
WALTER EDWIN HITCHCOCK,	<i>Book-keeper.</i>
MARY ALOYSIUS RILEY,	<i>Stenographer.</i>
EDWARD AUGUSTUS AUSTIN,	<i>Messenger,</i>

LOGAN WALLER PAGE, Geologist.

ANNUAL REPORT

OF THE

MASSACHUSETTS HIGHWAY COMMISSION.

The appropriation by which the work of the Highway Commission was to be carried on during the season of 1896 did not become available until nearly three months of that season had passed. The act by which this appropriation was made (chapter 481, Acts of 1896) was approved on June 4, and the amount of the appropriation was \$600,000.

After a careful consideration of the conditions, it was deemed wise not to undertake any absolutely new constructions, but rather to press forward the extension of those already begun. With one or two minor exceptions, for which there were excellent reasons, this determination has been adhered to.

As soon as possible after the appropriation was available allotments were made to the several constructions under way, the necessary surveys and estimates were completed as rapidly as possible, and contracts were entered into for the execution of the work. In addition to the lay-out of previous years, 195,481 feet were laid out during the year 1896, bringing the total length up to 665,937 feet, or 126.17 miles. The loss of three months of the best part of the road-making season by delay in the appropriation necessarily resulted in a diminished construction. Notwithstanding the exceptionally favorable weather during the month of November, extending even into the first week of December, the season of actual road building was comparatively short.

About 47 miles of highway were actually finished during the year, bringing the total amount of completed State road

up to about 109 miles. A number of extensions laid out and partially built must await their completion on the opening of the spring. A full account in detail of the work of the year on each of the several roads will be found in the Appendix to this report.

Up to the beginning of the year there had been received 224 petitions for State highways, from city officers, county commissioners and town authorities. The number has been increased during the year by 83, making the total 307. The petitions received this year represent 78 municipalities.

MEETINGS OF THE COMMISSION.

The commission has held 68 meetings at its office during the year, besides many other meetings at different points in the State.

The office of the commission, which was until July 25 at 15 Court Square, Boston, was removed on that day to one of the buildings belonging to the State, 4 Mt. Vernon Street, where rooms on the second and higher floors were assigned to it by the governor and council. In its new location the work of the commission is more conveniently carried on, and there is a saving of about \$3,000 per annum in rental and other expenses necessary at the quarters previously occupied.

Regular meetings were held in every county of the State, as provided for and required by the statutes. Notice was given of these meetings some weeks in advance, and an opportunity was afforded to county, town and municipal authorities and to the general public to discuss and consider matters relating to the construction of State roads or the improvement of highways in general. Still other meetings were held in different localities, whenever it seemed desirable to enable the commission to form a correct judgment as to the question of taking a roadway under a properly prepared petition.

Every road under construction has been visited during the year by one or more members of the commission, and no road has been finally accepted from the contractor until it has been inspected and a favorable report has been made.

CONTRACTS.

In the last report the desirability of awarding contracts for building State roads to the town or municipal authorities having jurisdiction where they are built was discussed and affirmed. The commission still believes in the wisdom of this course, and for the reasons there given, even if the cost of construction shall be slightly greater than if let to private contractors. In some localities, however, the authorities do not elect to take the contract, and the number of lettings to private parties is, on the whole, increasing. In some towns there has been a loss encountered by the contractor on the completion of the work, and this fact has in some degree discouraged the taking of contracts by municipal or town authorities. In rare cases this loss has been due to erroneous estimates by engineers in the service of the commission, generally resulting from unforeseen difficulties in procuring or handling material. Wherever this has been found to be the case, the commission has dealt liberally with the town authorities, by making allowances for extra labor or cost of material which had not been provided for in the estimates on which the contract is based. In other cases the loss can unquestionably be attributed to careless business methods on the part of the town authorities. While this is something over which the commission has no control, and which it is generally quite unable to prevent, it feels compelled to refer to the matter, and to call attention, as it did in its report of a year ago, to the fact that the Commonwealth suffers in some degree through the delay which usually accompanies this condition of things, requiring the maintenance of a resident engineer at the place of operation for a longer period than would otherwise be necessary.

Attention is also invited to the paragraph in the last report in which reference is made to the practice of town or city authorities of paying more than the usual rate of wages in that locality to laborers whom they employ on the State highway, or of employing those who are not able-bodied. Considered from the stand-point of an economical and fair expenditure of the funds of the Commonwealth, such a practice is not to be commended, and the

commission cannot be expected to consider losses which originate in this way.

The question of the employment of persons not citizens of the Commonwealth in the construction of State roads has several times arisen during the year. Such employment is a direct violation of the law, and the commission has felt compelled to take decisive action in all instances of which it has had knowledge. The procedure in such cases has been as follows: Whenever it is reported that non-citizens are employed, the chief engineer has been directed to investigate the matter and report at once to the commissioners. If the report is verified, the contractor is notified that such employment must cease immediately, and that on a repetition of the offence the contract will be annulled. This notification has been sufficient, except in the case of two contracts, where it came to the knowledge of the commissioners that the employment of persons not citizens was continued after such notice, and in these cases the contracts were immediately annulled.

In the interpretation of the word "citizen" the commission has sought the advice of the Attorney-General, and in accordance therewith it is assumed to have its full meaning, the possession of "first papers" being not sufficient to constitute citizenship.

The table of Appendix B shows all contracts made during the year, with prices in detail.

LEGISLATION.

As all the legislation under which the Highway Commission is working is recent, it naturally and necessarily follows that when subjected to the test of actual practice it is almost certain to prove defective in some respects. It seems desirable to call attention in this report to a few of the imperfections in the statutes, which have somewhat embarrassed the commission in its work, and which may be easily removed by proper legislative action.

The delays, resulting in real losses, due to the lateness of the annual appropriation in the year 1896 and as well in the previous year, suggest the desirability of the appropriation of a fixed annual sum for a period of years, say five or ten, the money to become available without further legislative

action. There can be no question but that great gain would result from such a course, through the better control which the commission would have over the whole work, and the more economical administration of its funds which would then be secured. The convenience of the general public would also be greatly promoted, through the possibility of the execution of field work during that season in which the temporary interruption of the usual lines of travel would offer the least annoyance. It is respectfully urged that this suggestion be favorably considered during the coming session of the Legislature.

The commission is not always able to do its work in the best and most economical manner on account of the restrictions of section 4, chapter 497 of the Acts of 1894, which, as interpreted by the Attorney-General, forbid the making of contracts for any part of the labor or material necessary to the construction of a highway, allowing only contracts for the entire construction of said State highway.

Experience has shown the great advisability of being able to contract at one time for the grading only, the finishing to be let separately at a later period or in another season. In many localities this sort of construction would produce much better results, and it ought to be possible for the commission to adopt it. Again, it has developed that in many localities the delivery of stone for use in building the road can be contracted for at a much lower rate in the autumn and winter than in the summer, when the actual construction of the highway can be carried on. Farmers and others who engage in the work are often idle during much of the winter; and the interests of all would be greatly furthered by a modification of the statutes, to the end that the commission might use its discretion in dividing the work of road construction, and making contracts in such number as is deemed wise.

The commission is of opinion that chapter 513 of the Acts of 1896, which provided for the purchase of road machinery on the application of the county commissioners of any county, is not a wise measure in its present form, and for that reason no sum has been inserted in the estimates for the purpose of carrying out its provisions.

As it now stands, there is no limit on the number of steam rollers and portable stone crushers for which any town may ask, except that of the amount of the appropriation for their purchase; and the commission has no discretion in the matter of granting such request, when regularly forwarded through the county commissioners. It is impossible to think that this was the intent of the Legislature in passing this act. The law also provides that, while such road machinery shall remain the property of the Commonwealth, it shall be managed and maintained under the direction of the county commissioners. This does not seem wise to the commission, as it throws the care of State property on county authorities, without any proper accountability for the same. If the machinery were to continue under the care of the Highway Commission, it would be more likely to be properly cared for, and, besides, could be utilized, when not needed by town authorities, in the scheme of repairs of State roads which must shortly be put in operation, or in their original construction, when convenient.

A modification of this act, to secure this and to correct the failure in limitation, is much to be desired.

Under the appropriation made in chapter 548, Acts of 1896, of \$12,000 to carry out the provisions of this act, road machinery was purchased and furnished to the several towns as follows:—

One steam roller to each of the following towns: Greenfield, Westfield, Palmer, Winchester, Natick and Ware, at a cost of	\$11,325 00
One portable stone crusher to the town of Palmer, at a cost of	637 50
Total,	\$11,962 50
Leaving a balance of \$37.50 unexpended.	

The commission is likely to find itself seriously embarrassed by the interpretation of chapter 541, Acts of 1896, which is an act relative to street railways located on public highways. By this act the commission is given authority to change the location, grade, paving, etc., of street railways, when it becomes necessary, in its opinion, to make such changes in the course of construction of a State highway.

But, if the owners of the railway shall so desire, the cost of making such change must be paid by the Highway Commission, the same to be repaid to the Commonwealth by said owners in ten equal annual instalments, with interest not exceeding four per cent. per annum.

The language of the statute is not clear as to whether this repayment is to become available to the Highway Commission when received by the State treasurer, or is to form a part of the common fund of the State treasury. As money loaned from the fund appropriated for the construction and maintenance of State highways, it would be only just that it should return again to that fund.

A more serious feature of this act is the failure to make permanent the jurisdiction which it temporarily bestows over the grade, location, etc., of street railways. In section 2, chapter 497 of the Acts of 1894, it is distinctly provided that, when a highway has been accepted and constructed as a State road, it shall continue to be maintained by the Commonwealth, under the supervision of the Highway Commission; and that all openings and placing of structures in any such road shall be done in accordance with a permit from said commission. It is elsewhere provided that the Commonwealth shall pay all damages for injuries incurred on such State highway, and it seems clear that it was the intent to give entire jurisdiction to the Commonwealth. It would be singular, indeed, if, after a State road was once completed, town or city authorities could assume jurisdiction over street railways lying within the highway bounds, and give or alter the grades or locations, as they chose. The welfare of the general public requires that there should be no uncertainty about this.

By a resolve approved on April 28, 1896, the Highway Commission is directed to report the probable cost, and such other information as may be obtained in relation thereto, of a State highway between the city of Boston and the city of Salem or the city of Newburyport, over the shore route, so called. This matter has received the special attention of one member of the commission, who was selected to make a detailed examination of the problem, and a report as directed by the act will be made at the proper time as

a separate report of the commission to the next General Court.

In order to obtain full rights over the original location of a highway, and also to secure a juster distribution of the cost of road construction, the commission recommends that towns in which it is proposed to construct highways be given authority to release the State from damages on account of land taken or changes of grade.

In accordance with the provisions of section 5, chapter 497, Acts of 1894, the commission has certified to the Auditor of the State the several amounts to be repaid to the Commonwealth by the counties in which State roads have been built up to the year 1896, the same being one-fourth of the total amount expended in highway construction in each county. The repayments are to be made at the end of six years from the date of the expenditure, or at such earlier date as the county authorities preferred. This plan was fixed upon, after a careful consideration of the subject by the commission, as being more likely to give general satisfaction than any other arrangement.

The total amount thus to be assessed for repayment on account of work done during the first two years of the operation of the commission, 1894 and 1895, is \$159,461.67.

THE EFFECT OF STATE ROADS ON THE DEVELOPMENT OF THE ROAD SYSTEM OF THE COMMONWEALTH.

At the outset of the work of the building of State roads there seemed some reason to fear that the municipalities would decrease their individual endeavors in the direction of better roads. It is a satisfaction to note that this has not been the case. At many points in the State the towns having taken contracts for the construction of State roads have, after the close of their engagements with the commission, proceeded, with the machinery which they had acquired for State work, to build ways on their own account. These additional roads have been patterned on those paid for by the Commonwealth, and are of excellent quality; and we may hope that the habit of road building will be fostered rather than hindered by the State aid.

GRAVEL ROADS.

The experience had in the construction of the gravel road in the town of Hingham, and with the endurance of the weight of traffic, has led the commission to undertake other constructions of this nature. At several points it proposes to begin a State road by the use of gravel as a hardening material, feeling that it may be found, after some years of experience, cheaper to maintain the way in that state. If the experience should not be to this effect, the gravel which has been applied will serve as an excellent foundation for broken stone.

It is believed that, with a well-conditioned gravel road which has been kept in a smooth state, the amount of broken stone required for use will be much less than under the ordinary conditions of construction, where the foundation of the road is not as firm as on a used way which does not have to be regraded.

The commission has also found the advantage of a preliminary construction of roads without any hardening material. On this account it has been determined to construct a considerable portion of the Cape Cod road in the town of Truro without, for the present, hardening any portion of it. This method has the advantage that it at once removes the difficulties, usually the most considerable, which arise from steep grades, thus bettering the condition of traffic, while it leads the way for the consolidation, which may cheapen the cost of hardening by diminishing the amount of broken stone or gravel which has to be used.

THE DISTRIBUTION OF STATE ROADS IN THE COMMON-WEALTH.

The selection of roadways which shall be rebuilt as State roads at the expense of the Commonwealth is naturally the most difficult problem with which the commission has to deal. The nature of that problem will be more readily understood after an examination of the map of the State, which forms a part of this report, on which is laid down, in addition to county and town boundaries, the roadways which the commission has been petitioned to take and those

which it has up to this date actually accepted as State roads, nearly all of the latter having been actually constructed.

Under the provisions of the law the commissioners are not permitted to control the expenditure of the appropriation entirely by their own judgment. They are restricted by two provisions, the wisdom of which they do not at all criticise, but which should always be kept in mind in considering the results of their labors. The first of these is that "all constructions of State roads shall be fairly apportioned among the different counties," and in this they have been guided in the main by the relative miles of roadway existing in the several counties. The second is the restriction growing out of the use of the petition. It was obviously the intention of the Legislature to limit the initiative of the Highway Commission in planning for the location of State ways. As is well known, the commission cannot of its own motion accept or reject any route; it has to await the petitions of the municipalities or the county commissioners. The only manner in which it can effect any satisfactory grouping of these petitions, so that continuous routes may come from the constructive work, is by rejecting the petitions which may come to it, or by counselling with the authorities having the right to petition in advance of their formal requests.

In order to keep the State roads from having a total lack of ultimate purpose in their relations to each other in the distribution of the Commonwealth, the commission has been compelled gradually, though not formally, to come to a state of mind as regards the selection of roads which are to be taken. In part this rather undetermined project is indicated by the distribution of the routes which have been accepted, as is shown on the accompanying map. In part, though less distinctly, it is indicated by the direction of the petitions, the greater part of which have been submitted after more or less conference with the commission.

It appears to your commission that the time has now come when some statement, still necessarily tentative, should be made which will set forth in a general way the views of the commission as to the policy to be followed by the Commonwealth in the construction of State roads. This statement is submitted in no sense as a hard-and-fast plan, but in order to

set forth the direction in which the work of the commission is inevitably drifting; and we should hope that this statement may provoke criticism, and, if need be, modification of the action.

It seems, in the first place, clear that the most important of the many needs which are to be met by the construction of State roads is that which relates to the connection of the centres of business in the Commonwealth with each other, in so far as the business relations demand this connection. Thus, where two towns have a large exchange of relations, the way lying through other towns which profit little by the traffic, there is good reason why the State should take charge of the main connecting way.

Closely related to this is the case of a considerable number of smaller, less populous towns, surrounding a large city or centre of dense population, with which they have intimate business relations. It furnishes the market for their products, and the profit to the producer as well as the cost to the consumers is largely determined by the cost of local transportation. Even where facilities for transportation by rail exist, there is still much use of the public highway whenever it is in reasonably good condition. It is in evidence before the commission that many articles of produce, especially perishable and delicate fruits, are preferably sent many miles to the city market in farm wagons, where shipping by rail would be both quicker and cheaper, on account of the better condition in which they may be delivered.

In making its selections among numerous petitions the commission has endeavored to keep in mind the great advantages arising from easy connections between large centres of population and the surrounding agricultural areas, for in so doing the demands of both urban and suburban populations are recognized and their mutual interests promoted.

Another class of cases arises, in which one or more towns lie remote from the rail or water ways, losing opportunities of advancement on account of this hindrance. These conditions are in some cases so grave that the average cost during the year of transporting a ton of freight from a village otherwise well placed for manufacturing to the business centres of the Commonwealth is greater than would be incurred in

transporting the same burden from the central portion of the Mississippi valley to the city of Boston. In these cases, also, the commission feels impelled to better the traffic conditions by improving the way.

In yet other, but not numerous, cases, portions of the States adjacent to this Commonwealth have their natural business centres in some of our cities or towns, but the people thus residing beyond the bounds of the Commonwealth are deterred from seeking access to its markets by the difficulties of the way. In such instances it seems desirable that good roads should be provided to the bounds of the Commonwealth.

The conditions above mentioned may be regarded as of a local character. There remains yet another of such interests of a general nature to be provided for. These will be met by so grouping the State roads that they will in the end afford continuous routes through the Commonwealth, which may serve the interests of pleasure travel or the occasional distant carriage which would be done by ordinary wagons where the roads were good. These extended ways, including in general those which relate to driving for a distance of more than fifteen miles, are of greater importance to the interests of the Commonwealth than might at first sight appear. A considerable part of the present and much of the prospective value of real estate in the Commonwealth, as well as of the traffic which takes place therein, is due to the incoming of people from the central and western parts of the country, who seek summer residences and family homes in the very attractive rural districts of the State. People who thus resort to the Commonwealth for recreation desire opportunities for driving such as would be afforded by a well-organized system of State ways, which would be laid out and beautified with some reference to the natural and historic interests of the country. It is hardly necessary to say that the use of the bicycle for pleasure travel would also be thus accommodated.

Although the commissioners do not propose to build roads which relate only or even mainly to pleasure travel, they feel that the service which can be done by a system which

relates to such travel is so great and of such economic importance to the Commonwealth that it should always be kept in mind.

An examination of the map referred to above will reveal in some degree the groupings of highways up to this time, as indicated by petitions and by acceptance. A few rather long, continuous lines of State highway are apparently demanded at the present time, and their construction ought to be kept in view in the acceptance of petitions; but the commission must not allow itself to be too much influenced by an adjustment of petitions, which often stand only for local interest and activity. While there is often good reason for accepting one highway on account of local conditions, although it may not form a part of any general scheme, and another because it does fit into such a scheme, although of less local value than another which may be near by, there is often equally good reason for postponing action on a third because it is relatively of less *immediate* importance than either of the others.

The commissioners are of opinion that nearly every mile of road thus far petitioned for should some time be built as a State highway; but it is clear that, as only a comparatively small number of miles can be completed annually, some selection must be made.

In choosing which shall be undertaken first, the commissioners must be governed by considerations of the broadest character, many of which will not be evident to those who necessarily think most of local interests. The order of presentation of petitions can have no influence, nor should it be inferred that, because a petition is not granted this year, it may not be next, or the year after. Outside of the limitations put upon them by the statute, the commissioners are bound to exercise their best judgment in all cases; and, while they are likely to be far from infallible, and welcome fair criticism, all who are unselfishly interested in the extension of this important system of State highway construction are likely to accept the judgment as the result of a comprehensive knowledge of the whole situation, growing out of the necessary consideration of the scheme as a whole.

ENGINEERING.

The engineering department was organized with Mr. Charles Mills in charge of all engineering and construction work, with Mr. J. C. S. Taber as assistant engineer in charge of surveying parties and office work and Mr. A. M. Lovis as office assistant.

Messrs. F. C. Pillsbury, W. R. Farrington and W. B. Wheeler have been employed as division engineers. Messrs. H. R. Starbird, H. P. Wires, G. R. Winslow and A. H. Peterson have been employed as chiefs of survey parties, with Messrs. E. N. Colburn, J. M. Kimball, W. A. Grover, H. A. Hall, E. P. McClintock, E. B. Walbridge, N. B. Wilber, J. M. Gilmore and J. F. Osborne as transitmen, and Messrs. J. J. Gleason, E. N. Sampson, F. H. Grover, M. L. Brown, Jr., C. A. Raymond, E. M. Noble and P. H. Belknap as rodmen. Messrs. H. V. Sandford, J. H. Taylor, H. C. Karlson, F. J. Nowell, J. P. Dahlgren, W. H. Sleeper and W. G. Burns have been employed in the draughting room.

ESTIMATES FOR WORK IN 1897.

So far the commissioners have hesitated from year to year to ask any increase in the amount of money placed at their disposal for the construction of State roads. This hesitation has been due to the fact that it was desirable to gain experience in the work, and to build up a small but effective corps of engineers who could be safely trusted with the undertakings. This experience and organization are now so far complete that your commissioners have no hesitation in recommending an appropriation of \$800,000 for the ensuing construction year.

In case the appropriation does not exceed that of the last year, it is doubtful whether the commissioners will find it possible to begin any new constructions. It is likely to appear, on a careful study of the conditions, most desirable to continue the roads now in hand. If, however, the sum of \$800,000 is appropriated, your commissioners estimate that it will be possible to begin new constructions at a considerable number of points in the Commonwealth.

For reasons already given, it is especially urged that the amount estimated for be made available annually for a series of not less than five years.

The commission has endeavored to favor in every way in its power the establishment of crusher plants. It has, therefore, held itself free to give advice to business men who might seek to establish such plants, thereby increasing the opportunities for obtaining broken stone, and it is particularly desirable that such plants should be established on Cape Cod.

One of the members of the commission has given much time to the study of distribution of road-building stones. As a part of the work of this study, careful experiments have been made and are being made as to the strength, cementation of value and other properties of all the varieties of stone which are in use in the Commonwealth. As the road is built it is the intention to have the materials thoroughly tested. These tests, when compared with the cost of repairs, will in the course of a few years begin to give exceedingly valuable information as to the relative utility of the diverse road-building materials which are found within the area of the Commonwealth. In Appendix G of this report will be found an account of the field and laboratory studies of road building in progress under the direction of the commission, and made by Mr. L. W. Page. It is a continuation of that in the report of last year.

The following is a summary of the expenditures of the Highway Commission during the year 1896. Although the statement shows a considerable amount of money unexpended at this date, it is the least amount needed to complete contracts already made and to meet the necessary expenses of the office.

EXPENDITURES OF THE MASSACHUSETTS HIGHWAY COMMISSION
For the Year ending Dec. 31, 1896.

COUNTIES.	Construction.	Repairs and Maintenance.	Totals.
Barnstable,	\$30,591 64	-	\$30,591 64
Berkshire,	32,797 72	\$322 28	33,120 00
Bristol,	46,616 76	235 45	46,852 21
Dukes,	14,494 72	33 84	14,528 56
Essex,	39,507 25	50 50	39,557 75
Franklin,	38,565 58	189 50	38,755 08
Hampden,	30,161 49	1,653 48	31,814 97
Hampshire,	37,112 78	988 64	38,101 42
Middlesex,	41,502 13	66 83	41,568 96
Nantucket,	8,110 02	10 83	8,120 85
Norfolk,	26,006 87	112 20	26,119 07
Plymouth,	39,927 23	415 27	40,342 50
Worcester,	73,186 69	648 37	73,835 06
Totals,	\$458,580 88	\$4,727 19	\$463,308 07

Total for construction, repairs and maintenance, \$463,308 07

Relocation of street railways (Leicester, 1896, road), 8,136 41

Engineering:—

Travel, including mileage, board and subsistence,	\$3,950 41
Supplies,	1,407 25
Salaries,	22,021 74
	—————
Salaries of commissioners,	6,000 00
Travel of commissioners,	1,270 69
Clerks and clerical assistance,	6,015 65
Rent of offices to Aug. 1, 1896,	1,875 00
Incidentals:—	
Advertising,	\$236 90
Printing, including postal cards and stamped envelopes,	1,139 62
Amounts carried forward,	\$1,376 52
	\$513,985 22

<i>Amounts brought forward,</i>	\$1,876 52	\$513,985 22
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Incidentals—*Con.*

Stationery,	191 05
Telephone, including tolls,	242 32
Light,	91 68
Janitor to Aug. 1, 1896,	147 00
Fixtures, including two safes,	645 83
Minor items, including repairs, telegrams, express charges, etc.,	<hr/> 571 91
	3,266 31
Mileage partially used,	<hr/> 560 00
Grand total,	<hr/> \$517,811 53

NOTE.—This year's expenditure includes \$600 in mileage and cash drawn on requisition which appeared in the 1896 report as partially used.

T. C. MENDENHALL,
 N. S. SHALES,
 W. E. McCLINTOCK,
Massachusetts Highway Commission.



APPENDIX.

APPENDIX A.

REPORT OF CHIEF ENGINEER.

BOSTON, MASS., Dec. 31, 1896.

To the Massachusetts Highway Commission.

GENTLEMEN:—I herewith submit the following report of work performed during the year 1896:—

The fall of the year 1895 being favorable to out-of-door work, construction was continued until the appropriation made had been practically expended.

As it was necessary for the commissioners to know the amount to be appropriated by the Legislature before the amounts to be allotted for the work in the different municipalities during the year 1896 could be determined, all the lay-outs were necessarily made after such determination, and, the appropriation not having been made by the Legislature until June 4, 1896, it was not until the first of the month of July following that construction work could be begun. As a consequence of this delay, location and construction were in progress at the same time, and a large force of engineers and assistants was necessarily employed. More than two months of the best season for road work having passed before the beginning of new constructions, it was necessary to have the work done in four months, which required a very large addition to the number of resident engineers employed, and but a portion of these men could be advantageously retained during the winter season. If appropriations were passed by the Legislature in season to permit of the work being begun as soon as the weather was favorable, a smaller force of engineers could be used to better advantage.

All the work laid out in the years 1894 and 1895 has been completed, with the exception of a small section in the town of Scituate.

Construction work during the past year has been carried on under 118 different contracts, covering 116 lay-outs, made in 68 different cities and towns.

The following statement shows the amount of work done in 1896:—

176,634.1 cubic yards of earth excavation.

5,125.14 cubic yards of ledge excavation.

5,275.93 cubic yards of rubble masonry, laid dry.

575.32 cubic yards of rubble masonry, laid in cement.
 43,521.88 cubic yards of gravel.
 21,941.91 square yards of telford.
 530,809.3 square yards of shaping for broken stone.
 146,068.75 tons of broken stone.
 9,514.70 lineal feet of vitrified clay pipe, exclusive of side drains.
 70,149.4 lineal feet of guard rail.
 34,058 lineal feet of side drains.
 14,017 square yards of cobble-stone gutters.
 1,322 stone monuments set.

STATEMENT OF APPROPRIATION AND EXPENDITURES FOR 1896.

The Legislature of 1896 appropriated \$600,000.

Amounts expended in each county for road construction during the year ending Dec. 31, 1896, including salaries of resident engineers, survey work done after signing of contracts, cost of stone bounds and other items properly charged to the roads:—

Barnstable County,	\$30,591 64
Berkshire County,	32,797 72
Bristol County,	46,616 76
Dukes County,	14,494 72
Essex County,	39,507 25
Franklin County,	38,565 58
Hampden County,	30,161 49
Hampshire County,	37,112 78
Middlesex County,	41,502 13
Nantucket County,	8,110 02
Norfolk County,	26,006 87
Plymouth County,	39,927 23
Worcester County,	73,186 69
Total,	\$458,639 38
Expended for surveys, including travel of engineers, not charged to construction accounts, instruments, etc., . . .	27,879 40
Total,	\$485,960 25

MAINTENANCE AND REPAIRS.

The amount expended in maintenance (\$4,727.19) has for the most part been because of damages caused by spring freshets, the most notable being those caused at Westfield, Russell and Huntington, by the overflow of the Westfield River, and at Hadley, by the overflow of the Connecticut River.

The expense of repairs has been mostly confined to the cleaning of gutters and the filling in of gullies formed in the slopes by the flow of surface water. The seeding of the slopes will obviate most of the repairs of this nature.

Table showing the highways constructed or contracted for by the commission, and the nature of the several constructions, to Jan. 1, 1897. Continued.

sent to the state, the first such group. The aim

When I first saw this, I thought it was a good idea. But then I realized that it was just a waste of time.

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table showing the highways constructed or contracted for by the commission, and the nature of the several constructions, to June 1, 1897. Concluded.

• Station 19 foot wide in cuts north 20 feet wide on embankments

2. Widths

Static Item Collection, Patient Input and Local Context



Another important outlay in the maintenance account has been brought about by the tendency to travel in one track. This has caused, in many places, a single line of the road to be worn for a width of one and one-half to two feet; it has been necessary to fill these depressions with broken stone. In order to call the attention of the drivers to the damage caused by driving in the centre of the way there have been placed on a number of roads signs requesting that the driving be not confined to the middle of the road, and as a result it is found in a great number of cases that the travel has been spread over the surface of the roadway in a satisfactory manner.

WIDTH OF TRAVELED WAY.

As much criticism has been made concerning the width of the travelled way covered with broken stone, I have had the widths ordinarily travelled taken on the following roads, a study of which will show that the proportion of the roadway travelled to the portion constructed has been largely over-estimated. The width graded on all roads undertaken, with the exception of two, viz., Truro and West Tisbury, has not been less than twenty-one feet. The widths given in the following table are in feet. In each case, in addition to the width of the macadam, there is a shoulder at least three feet in width, built of gravel or broken stone, and rolled by a steam roller, on each side of the macadam, and in many cases it exceeds three feet in width.

The following table will show the width of the macadam, the entire width of the travelled way, and the width of the commonly travelled portion on the various roads in the different cities and towns: —

TOWN OR CITY.	County.	Width of Macadam.	Maximum Width of Travelled Way.	Width of Commonly Travelled Way.
Andover, . . .	Essex, . . .	18	24	24
Ashby, . . .	Middlesex, . . .	20-15	12	9
Athol, . . .	Worcester, . . .	17	16	10-12
Auburn, . . .	Worcester, . . .	15	12	9
Beverly, . . .	Essex, . . .	18	20-24	20
Buckland, . . .	Franklin, . . .	24-15	10	7-9
Dalton, . . .	Berkshire, . . .	15	20	20
Deerfield, . . .	Franklin, . . .	15	12-14	11

TOWN OR CITY.	County.	Width of Macadam.	Maximum Width of Travelled Way.	Width of Commonly Travelled Way.
Duxbury, . . .	Plymouth, . . .	15	12-14	7
Easthampton, . . .	Hampshire, . . .	15	12-13	9-10
Fitchburg, . . .	Worcester, . . .	15	15	10
Gloucester, . . .	Essex, . . .	15	15	15
Goshen, . . .	Hampshire, . . .	15	10	7
Granby, . . .	Hampshire, . . .	15	9	5
Hadley, . . .	Hampshire, . . .	15	15-18	10
Hingham, . . .	Plymouth, . . .	15	17	10
Holden, . . .	Worcester, . . .	18-15	13-18	10
Huntington, . . .	Hampshire, . . .	15	9	7
Lee, . . .	Berkshire, . . .	24-15	21-15	12-15
Leicester, . . .	Worcester, . . .	24-15	15	10-12
Lexington, . . .	Middlesex, . . .	15	15-20	15
Lincoln, . . .	Middlesex, . . .	15	15	10
Marion, . . .	Plymouth, . . .	15	15	10
Marshfield, . . .	Plymouth, . . .	15	14	8
Middleborough, . . .	Plymouth, . . .	15	25-30	20-25
Monson, . . .	Hampden, . . .	15	12	8-10
Nantucket, . . .	Nantucket, . . .	15	-	-
Newburyport, . . .	Essex, . . .	15	15	8-10
North Adams, . . .	Berkshire, . . .	15	10-12	8-10
Norfolk, . . .	Norfolk, . . .	15	10	10
North Attleborough, . . .	Bristol, . . .	24-15	15-20	10-15
Northampton, . . .	Hampshire, . . .	20	18	12
Norwood, . . .	Norfolk, . . .	15	18	10-15
Orange, . . .	Franklin, . . .	17	16	10-12
Paxton, . . .	Worcester, . . .	15	13	9
Plymouth, . . .	Plymouth, . . .	15	15	9
Rehoboth, . . .	Bristol, . . .	15	9	9
Russell, . . .	Hampden, . . .	15	8-10	7
Scituate, . . .	Plymouth, . . .	15	14	8
Shelburne, . . .	Franklin, . . .	18-15	12-15	8
Shrewsbury, . . .	Worcester, . . .	18-15	18-12	12-7
Somerset, . . .	Bristol, . . .	15	15	9
South Hadley, . . .	Hampshire, . . .	15	15	10
Taunton, . . .	Bristol, . . .	15	20	10-15

TOWN OR CITY.	County.	With of Macadam.	Maximum Width of Travelled Way.	Width of Commonly Travelled Way.
Tyngsborough, . . .	Middlesex, . . .	15	10	10
Walpole, . . .	Norfolk, . . .	15	15	8
Warren, . . .	Worcester, . . .	15	13	7
Watertown, . . .	Middlesex, . . .	27	33	25-30
Westfield, . . .	Hampden, . . .	18-15	13	9
Westminster, . . .	Worcester, . . .	15	15	9
West Newbury, . . .	Essex, . . .	15	14	8
Westport, . . .	Bristol, . . .	18	14	14
West Springfield, . . .	Hampden, . . .	18	15-12	10
Weymouth, . . .	Norfolk, . . .	15	21	21
Whitman, . . .	Plymouth, . . .	18	15	11
Wilbraham, . . .	Hampden, . . .	15	8-9	7
Williamstown, . . .	Berkshire, . . .	15	10-12	9
Average, . . .	. . . . .	16.10	14.92	11.05

All of which is respectfully submitted,

CHAS. MILLS,
Chief Engineer.

APPENDIX B.

SHOWING CONTRACT PRICES ON STATE ROADS DURING 1894-96.

TOWN OR CITY.		Contractor.	EXCAVATION.						RUBBLE MASONRY.						BROKEN STONE.						Bounds.				
Number of Code.	Number of Code.		All Kinds.	Gravel.	Gravel.	Gravel.	Gravel.	Gravel.	Clay.	Clay.	Dr.	Cement.	Gravel.	Tefford.	Shaplock.	Trap.	Side Drains.	Vitrified Clay Pipe, 12 Inch.	Linear Foot.	Linear Foot.	Linear Foot.	Linear Foot.	Linear Foot.	Linear Foot.	Each.
Audoror, 1895, -	47	Town, A. J. Wellington.	\$0.25	\$1.50	\$1.35	\$0.30	\$0.30	\$0.30	\$0.30	\$0.30	\$0.30	\$0.30	\$0.30	\$0.30	\$0.30	\$0.30	\$0.30	\$0.30	\$2.06	\$0.60	\$0.60	\$0.60	\$0.60	\$0.60	\$1.25
Audoror, 1896, -	160	Town, A. J. Wellington.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	\$1.32	\$0.33	\$0.33	\$0.33	\$0.33	\$0.33	\$1.25
Ashby, 1894, -	2	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.80	60	15	-	-	-	60
Ashby, 1895, -	49	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.67	-	-	-	-	-	60
Ashby, 1896, -	109	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.17	60	15	25	50	50	1.25
Ashby, 1896, -	109	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.40	60	15	25	50	50	1.25
Athol, 1895, -	70	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.98	60	15	33	50	50	1.50
Athol, 1895, -	130	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.18	60	15	33	50	50	1.50
Athol, 1896, -	71	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.95	60	15	33	50	50	1.50
Athburn, 1895, -	148	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.30	60	15	33	50	50	1.50
Athburn, 1896, -	148	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.50	60	15	33	50	50	1.50
Ashbury, 1895, -	106	City, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.00	60	15	33	50	50	1.25
Ashbury, 1896, -	82	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.83	60	15	33	50	50	1.25
Brewster, 1896, -	124	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.83	60	15	33	50	50	1.25
Brewster, 1896, -	27	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.92	60	15	33	50	50	1.00
Buckland, 1894, -	72	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.86	60	15	33	50	50	1.50
Buckland, 1895, -	133	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.05	60	15	33	50	50	1.50
Buckland, 1896, -	133	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.00	60	15	33	50	50	1.50
Bottage City, 1894, -	14	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.97	-	-	-	-	-	1.50
Bottage City, 1894, -	44	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.91	-	-	-	-	-	-
Bottage City, 1895, -	123	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60	15	33	50	50	50	1.50
Bottage City, 1896, -	134	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52.00	-	-	-	-	-	-
Bolton, 1895, -	63	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.95	60	15	33	50	50	1.50
Bolton, 1896, -	118	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.95	60	15	33	50	50	1.50
Beefield, 1895, -	73	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.10	60	15	33	50	50	1.50
Beefield, 1896, -	103	Town, -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.05	60	15	33	50	50	1.50

1 Borrow.	2 Red granite.	3 Local trap.	4 Lower coarse red granite.	5 Also beach stone for foundation, 90 cents per ton.	6 Saud.
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- 1 Borrowing 3 feet or less.
- 2 Red granite.
- 3 Local trap.
- 4 Lower course red granite.
- 5 Also top rail for fencing, 4 cents per linear foot.
- 6 Saud.
- 7 Opening more than 3 feet.
- 8 Opening 3 feet or less.
- 9 Unpainted.
- 10 Painted.
- 11 Screened.
- 12 Also beach stone for foundation, 50 cents per ton.
- 13 Granite.
- 14 Top rail for fencing, 4 cents per linear foot.

¹² Also top rail for tening, * cens per linear foot.
Opening 3 feet or less. ⁸ Opening more than 3 feet.
Lining same as gravel road. ¹⁴ Also moving and rebuilding common wall, \$125. per rod.
Opening 3 feet or less. ¹⁰ Painted. ¹⁵ Different haul.

CONTRACT PRICES ON STATE ROADS, ETC. — *Continued.*

CONTRACT PRICES ON STATE ROADS, ETC. — *Concluded.*

APPENDIX D.

LIST OF COMPLETED ROADS, SHOWING DATES OF
FINAL ACCEPTANCE OF WORK DONE UNDER
CONTRACTS FOR CONSTRUCTION.

CITY OR TOWN.	Date of Lay-out.	Number of Contract.	Contractor.	Date of Acceptance of Work.
Ashby, . . .	1894	2	Town, . . .	Aug. 6, 1896.
Ashby, . . .	1895	49	Town, . . .	Aug. 6, 1896.
Auburn, . . .	1895	71	Town, . . .	Aug. 6, 1896.
Beverly, . . .	1895	106	City, . . .	Nov. 19, 1896.
Brewster, . . .	1895	82	Town, . . .	Nov. 19, 1896.
Brewster, . . .	1896	124	Town, . . .	Nov. 19, 1896.
Buckland, . . .	1894	27	Town, . . .	Aug. 6, 1896.
Cottage City, . . .	1894	14	Town, . . .	Aug. 6, 1896.
Deerfield, . . .	1894	108	Town, . . .	Nov. 28, 1896.
Deerfield, . . .	1895	73	Town, . . .	Aug. 6, 1896.
Dennis, . . .	1895	53	Town, . . .	Nov. 19, 1896.
Duxbury, . . .	1894	33	Town, . . .	Aug. 6, 1896.
Duxbury, . . .	1895	50	Town, . . .	Aug. 6, 1896.
Easthampton, . . .	1895	83	Town, . . .	Nov. 28, 1896.
Easthampton, . . .	1896	125	Town, . . .	Nov. 28, 1896.
Fairhaven, . . .	1894	21	Town, . . .	Aug. 6, 1896.
Fairhaven, . . .	1895	64	Town, . . .	Aug. 6, 1896.
Fitchburg, . . .	1894	4	City, . . .	June 18, 1895.
Gloucester, . . .	1894	39	City, . . .	Aug. 6, 1896.
Goshen, . . .	1894	10	Town, . . .	Aug. 6, 1896.
Granby, . . .	1894	31	Town, . . .	Aug. 6, 1896.
Great Barrington, . . .	1894	23	Town, . . .	Aug. 6, 1896.
Hadley, . . .	1894	15	Town, . . .	Aug. 6, 1896.
Hadley, . . .	1895	74	Town, . . .	Aug. 6, 1896.
Hadley, . . .	1896	135	Town, . . .	Nov. 28, 1896.
Hancock, . . .	1895	97	Hendrick, Taylor & Warner.	Oct. 22, 1896.
Hingham, . . .	1894	26	Town, . . .	Aug. 6, 1896.
Holden, . . .	1894	16, 25	Town, . . .	Aug. 6, 1896.
Holden, . . .	1895	75	Town, . . .	Aug. 6, 1896.
Lee, . . .	1894	20, 54	Town, . . .	Aug. 6, 1896.
Lee, . . .	1895	99	Town, . . .	Aug. 6, 1896.
Leicester, . . .	1894	5, 24, 42	Town, . . .	Aug. 6, 1896.
Lincoln, . . .	1895	65	Town, . . .	Aug. 6, 1896.
Marion, . . .	1894	3	Town, . . .	Aug. 6, 1896.
Marshfield, . . .	1894	28	Town, . . .	Aug. 6, 1896.
Mattapoisett, . . .	1894	19	Town, . . .	Aug. 6, 1896.
Mattapoisett, . . .	1895	76	Town, . . .	Aug. 6, 1896.
Middleborough, . . .	1894	29	Town, . . .	Aug. 6, 1896.
Monson, . . .	1894	52	Town, . . .	Aug. 6, 1896.
Nantucket, . . .	1894	9	Town, . . .	July 23, 1896.
Nantucket, . . .	1895	85, 107	Town, . . .	July 23, 1896.

LIST OF COMPLETED ROADS, ETC.—*Concluded.*

CITY OR TOWN.	Date of Lay-out.	Number of Contract.	Contractor.	Date of Acceptance of Work.
North Adams, .	1894	40	Town, . . .	Aug. 6, 1896.
North Attleborough, .	1894	8	Town, . . .	Aug. 6, 1896.
North Attleborough, .	1895	77	Town, . . .	Aug. 6, 1896.
Norfolk, . . .	1895	93	Hendrick, Taylor & Warner.	Nov. 12, 1896.
Northampton, .	1894	12	City, . . .	Nov. 28, 1896.
Paxton, . . .	1895	62	Town, . . .	Aug. 6, 1896.
Pittsfield, . . .	1894	17	City, . . .	Aug. 6, 1896.
Plymouth, . . .	1894	35	Town, . . .	Aug. 6, 1896.
Plymouth, . . .	1895	43	Town, . . .	Aug. 6, 1896.
Russell (Fairfield) .	1894	22	Town, . . .	Aug. 6, 1896.
Russell (Huntington), . . .	1894	11	Town, . . .	Aug. 6, 1896.
Shelburne, . . .	1894	36	Town, . . .	Aug. 6, 1896.
Shelburne, . . .	1895	57	Town, . . .	Aug. 6, 1896.
Taunton, . . .	1895	91	City, . . .	Aug. 6, 1896.
Tisbury, . . .	1894	7	Town, . . .	Aug. 6, 1896.
Walpole, . . .	1894	30	Town, . . .	Aug. 6, 1896.
Westfield, . . .	1894	6	Town, . . .	Aug. 6, 1896.
Westfield, . . .	1896	159	Town, . . .	Dec. 17, 1896.
Westminster, . . .	1894	13	Town, . . .	Aug. 6, 1896.
West Newbury, . . .	1895	98	C. H. Kelleher, .	Aug. 6, 1896.
West Springfield, .	1895	104	Town, . . .	Nov. 19, 1896.
West Springfield, .	1896	166	Town, . . .	Nov. 19, 1896.
Wilbraham, . . .	1895	105	Myron R. Fisk, .	July 16, 1896.
Wrentham, . . .	1894	18	Town, . . .	Aug. 6, 1896.
Wrentham, . . .	1895	61	Town, . . .	Aug. 6, 1896.
Yarmouth (North), .	1894	38	Town, . . .	Aug. 6, 1896.
Yarmouth (North), .	1895	60	Town, . . .	Aug. 6, 1896.
Yarmouth (South), .	1895	92	Town, . . .	Oct. 22, 1896.

APPENDIX E.

TABLE SHOWING TOWNS AND CITIES IN WHICH WORK HAS BEEN DONE DURING THE YEAR 1896, THE RESIDENT ENGINEERS ON SUCH WORK, TOGETHER WITH DATES OF BEGINNING AND ENDING OF WORK.

TOWN OR CITY.	County.	Lay-out.	Resident Engineer.	Date of Contract.	Date of Beginning.	Date of Ending.
Andover,	Essex,	1896	Manwell, F. P., Wheeler, R. C.,	Oct. 8, 1896; June 27, 1895.	Oct. 27, 1896; May 27, 1895.	Dec. 19, 1896; June 4, 1896.
Ashby,	Middlesex,	1895.	Wheeler, R. C.,	July 6, 1896.	June 19, 1896.	July 14, 1896.
Ashby,	Middlesex,	1896	Clark, W. J.,	July 6, 1896.	July 14, 1896.	July 30, 1896.
Ashby,	Middlesex,	1896	Belknap, F. W.,	Aug. 7, 1895.	June 23, 1896.	Aug. 22, 1896.
Athol,	Worcester,	1895	Lyman, A. F.,	Aug. 7, 1895.	Oct. 26, 1896.	Nov. 18, 1896.
Athol,	Worcester,	1895	Wheeler, W. B.,	Aug. 7, 1895.	Nov. 19, 1896.	Dec. 7, 1896.
Athol,	Worcester,	1896	Belknap, F. W.,	Aug. 6, 1896.	Aug. 22, 1896.	Oct. 21, 1896.
Athol,	Worcester,	1896	Lyman, A. F.,	Aug. 6, 1896.	Oct. 26, 1896.	Nov. 18, 1896.
Athol,	Worcester,	1896	Wheeler, W. B.,	Aug. 6, 1896.	Nov. 19, 1896.	Dec. 14, 1896.
Athol,	Worcester,	1895	Johnston, J. A.,	Aug. 8, 1895.	May 18, 1896.	July 3, 1896.
Auburn,	Worcester,	1895	Everett, P. H.,	Aug. 27, 1896.	Sept. 23, 1896.	Nov. 23, 1896.
Auburn,	Essex,	1895	Foster, E. S.,	Oct. 7, 1895.	June 15, 1896.	Oct. 7, 1896.
Beverly,	Barnstable,	1895	Maynard, G. F.,	Aug. 15, 1895.	June 8, 1896.	Aug. 1, 1896.
Brewster,	Barnstable,	1896	Maynard, G. F.,	July 23, 1896.	Aug. 1, 1896.	Aug. 28, 1896.
Brewster,	Barnstable,	1896	Farrington, W. R.,	July 23, 1896.	Aug. 29, 1896.	Sept. 5, 1896.
Buckland,	Franklin,	1895	Wood, G. W.,	Aug. 8, 1895.	June 22, 1896.	Nov. 14, 1896.
Buckland,	Franklin,	1896	Wood, G. W.,	Aug. 13, 1896.	Oct. 19, 1896.	Dec. 5, 1896.
Cottage City,	Dukes,	1895	Crowell, J. H.,	June 10, 1895.	June 22, 1896.	Oct. 3, 1896.
Cottage City,	Dukes,	1896	Crowell, J. H.,	July 16, 1896.	July 17, 1896.	Sept. 26, 1896.

Dalton,	1895	Jones, L. H.,	Aug. 2, 1895,	June 15, 1896,	Nov. 14, 1896,
Dalton,	1896	Jones, L. H.,	July 16, 1896,	Aug. 14, 1896,	Nov. 20, 1896,
Deerfield,	1894	Litchfield, S.,	June 18, 1896,	July 15, 1896,	Oct. 6, 1896,
Deerfield,	1895	Belknap, F. W.,	Aug. 8, 1895,	May 27, 1896,	June 5, 1896,
Dennis,	1895	Norton, C. H.,	July 11, 1895,	June 17, 1896,	Oct. 23, 1896,
Dennis,	1896	Norton, C. H.,	Sept. 24, 1896,	Oct. 26, 1896,	Dec. 10, 1896,
Easthampton,	1895	Johnston, J. A.,	Aug. 15, 1895,	July 8, 1896,	July 16, 1896,
Easthampton,	1895	Wheeler, R. C.,	Aug. 15, 1895,	July 17, 1896,	Sept. 1, 1896,
Easthampton,	1896	Wheeler, R. C.,	July 23, 1896,	Sept. 1, 1896,	Oct. 3, 1896,
Worcester,	1895	Stuart, F. M.,	Sept. 26, 1895,	June 18, 1896,	Nov. 28, 1896,
Essex,	1895	Brown, C. L.,	Aug. 20, 1896,	Sept. 2, 1896,	Nov. 6, 1896,
Goshen,	1895	Nickerson, E.,	Aug. 15, 1895,	July 30, 1896,	Sept. 26, 1896,
Great Barrington,	1896	Power, E. P.,	Sept. 24, 1896,	Oct. 12, 1896,	Dec. 29, 1896,
Hadley,	1894	Belknap, F. W.,	Sept. 25, 1894,	Oct. 11, 1896,	May 16, 1896,
Hadley,	1895	Belknap, F. W.,	Aug. 8, 1895,	May 16, 1896,	May 26, 1896,
Hadley,	1896	Fosten, F. H.,	Aug. 13, 1896,	Sept. 22, 1896,	Oct. 10, 1896,
Hadley,	1896	Hammersley, W. P.,	Aug. 13, 1896,	Oct. 10, 1896,	Nov. 20, 1896,
Berkshire,	1895	Pillsbury, F. C.,	Sept. 5, 1895,	Jan. 1, 1896,	Jan. 25, 1896,
Berkshire,	1895	Pillsbury, F. C.,	Sept. 5, 1895,	June 22, 1896,	July 23, 1896,
Berkshire,	1895	Hight, C. M.,	Sept. 5, 1895,	July 24, 1896,	Oct. 1, 1896,
Berkshire,	1896	Williams, C. G.,	Aug. 27, 1896,	Sept. 24, 1896,	Nov. 28, 1896,
Berkshire,	1896	Williams, C. G.,	Oct. 22, 1896,	Oct. 26, 1896,	Nov. 28, 1896,
Berkshire,	1896	Fosten, F. H.,	Oct. 22, 1896,	Oct. 28, 1896,	Nov. 17, 1896,
Berkshire,	1896	Belknap, F. W.,	Oct. 22, 1896,	Nov. 17, 1896,	Dec. 17, 1896,
Holden,	1896	Warren, H. E.,	Sept. 24, 1896,	Oct. 9, 1896,	Dec. 9, 1896,
Hingham (1),	1895	Power, E. P.,	July 18, 1895,	July 16, 1896,	Sept. 19, 1896,
Hingham (2),	1895	Belknap, F. W.,	July 18, 1895,	Oct. 24, 1896,	Oct. 31, 1896,
Holbrook,	1896	Power, E. P.,	July 30, 1896,	Aug. 10, 1896,	Oct. 10, 1896,
Holbrook,	1896	Belknap, F. W.,	July 30, 1896,	Oct. 24, 1896,	Nov. 13, 1896,
Holden,	1896	Grimes, M. W.,	Aug. 27, 1896,	Sept. 11, 1896,	Nov. 10, 1896,
Huntington,	1895	Shaw, S.,	June 25, 1895,	May 18, 1896,	June 2, 1896,
Leicester,	1895				

TABLE SHOWING TOWNS AND CITIES IN WHICH WORK HAS BEEN DONE, ETC. — *Continued.*

TOWN OR CITY.	County.	Lay-out.	Resident Engineer.	Date of Contract.	Date of Beginning.	Date of Ending.
Leicester,	Worcester,	1896	Murray, J. D.,	July 16, 1896	July 31, 1896	Aug. 28, 1896.
Leicester,	Worcester,	1896	Johnston, J. A.,	July 16, 1896	Sept. 21, 1896	Dec. 12, 1896.
Lexington,	Middlesex,	1895	Wason, H. B.,	Aug. 2, 1895	June 9, 1896	Aug. 29, 1896.
Lexington,	Middlesex,	1896	Wason, H. B.,	July 6, 1896	July 9, 1896	Aug. 29, 1896.
Lincoln,	Middlesex,	1895	Bailey, W. K.,	Aug. 2, 1895	Nov. 2, 1896	Nov. 13, 1896.
Lincoln,	Middlesex,	1896	Bailey, W. K.,	July 9, 1896	Aug. 11, 1896	Nov. 17, 1896.
Marion,	Plymouth,	1895	Ruggles, E. F.,	Aug. 2, 1895	June 17, 1896	Oct. 10, 1896.
Marshfield,	Plymouth,	1896	Whislow, D. H.,	July 30, 1896	Aug. 28, 1896	Dec. 15, 1896.
Middleborough,	Plymouth,	1895	Shaw, S.,	June 27, 1895	June 24, 1896	Aug. 28, 1896.
Middleborough (1),	Plymouth,	1896	Shaw, S.,	July 23, 1895	July 24, 1896	Aug. 26, 1896.
Middleborough (2),	Plymouth,	1896	Shaw, S.,	Aug. 13, 1896	Aug. 28, 1896	Dec. 12, 1896.
Nantucket,	Nantucket,	1895	Murray, J. D.,	Nov. 23, 1895	Jan. 1, 1896	Feb. 29, 1896.
Nantucket,	Nantucket,	1896	Murray, J. D.,	Nov. 5, 1896	Oct. 14, 1896	Dec. 31, 1896.
Newburyport,	Essex,	1896	Foster, E. S.,	Oct. 1, 1896	Oct. 14, 1896	Dec. 5, 1896.
Norfolk,	Norfolk,	1895	Grimes, M. W.,	Oct. 3, 1895	April 24, 1896	Aug. 13, 1896.
Norfolk,	Berkshire,	1895	Wason, H. B.,	Sept. 24, 1896	Nov. 6, 1896	Nov. 28, 1896.
North Adams,	Berkshire,	1896	Murray, J. D.,	Aug. 27, 1896	Sept. 3, 1896	Oct. 5, 1896.
North Adams,	Bristol,	1896	Wheeler, R. C.,	Aug. 27, 1896	Oct. 5, 1896	Nov. 27, 1896.
North Attleborough,	Bristol,	1896	Warner, P. A.,	Sept. 1, 1896	Sept. 17, 1896	Nov. 5, 1896.
North Attleborough,	Bristol,	1896	Joyer, F. H.,	Sept. 1, 1896	Nov. 5, 1896	Dec. 1, 1896.
North Attleborough,	Bristol,	1896	Wheeler, R. C.,	Sept. 1, 1896	Dec. 7, 1896	Dec. 11, 1896.
North Attleborough,	Bristol,	1896	Keene, T. M.,	Sept. 1, 1896	Sept. 14, 1896	Sept. 16, 1896.
Norwood,	Norfolk,	1895	Manwell, F. P.,	Sept. 26, 1895	Oct. 12, 1896	Oct. 14, 1896.
Norwood,	Franklin,	1896	Manwell, F. P.,	Aug. 6, 1896	Aug. 21, 1896	Oct. 15, 1896.
Orange,	Franklin,	1894	Brooks, S. H.,	June 25, 1895	June 17, 1896	Sept. 1, 1896.
Orange,	Franklin,	1894	Wheeler, W. B.,	June 25, 1895	Sept. 2, 1896	Sept. 9, 1896.

Orange, .	1894	Franklin, .	Lyman, A. F.,	Sept. 10, 1896,	Nov. 17, 1896,
Orange, .	1894	Franklin, W. B.,	Wheeler, W. B.,	June 25, 1896,	Nov. 28, 1896.
Orange, .	1895	Brooks, S. H.,	Brooks, S. H.,	June 25, 1895,	Nov. 18, 1896,
Orange, .	1895	Wheeler, W. B.,	Wheeler, W. B.,	July 18, 1895,	June 17, 1896,
Orange, .	1895	Lyman, A. F.,	Lyman, A. F.,	July 18, 1895,	Sept. 2, 1896,
Orange, .	1895	Wheeler, W. B.,	Wheeler, W. B.,	July 18, 1895,	Sept. 10, 1896,
Paxton, .	1895	Wheeler, W. B.,	Johnston, J. A.,	July 18, 1895,	Nov. 18, 1896,
Worcester, .	1896	Johnston, J. A.,	Johnston, J. A.,	Aug. 1, 1896,	July 18, 1896,
Plymouth, .	1895	Jones, L. H.,	Jones, L. H.,	July 6, 1896,	July 18, 1896,
Plymouth, .	1896	Nickerson, E.,	Nickerson, E.,	June 25, 1895,	May 22, 1896,
Bristol, .	1895	Warren, H. E.,	Warren, H. E.,	Oct. 22, 1896,	Nov. 24, 1896,
Bristol, .	1896	Warren, H. E.,	Warren, H. E.,	Aug. 15, 1895,	July 17, 1896,
Hampden, .	1894	Pillsbury, F. C.,	Pillsbury, F. C.,	July 9, 1896,	Sept. 22, 1896,
Hampden, .	1895	Power, E. P.,	Power, E. P.,	Oct. 4, 1894,	May 3, 1896,
Hampden, .	1896	Pierce, J. W.,	Pierce, J. W.,	July 25, 1895,	Sept. 3, 1896,
Hampden, .	1896	Pierce, J. W.,	Pierce, J. W.,	July 16, 1896,	July 23, 1896,
Plymouth, .	1894	Pillsbury, J. H.,	Pillsbury, J. H.,	Sept. 1, 1896,	Sept. 1, 1896,
Plymouth, .	1895	Pillsbury, J. H.,	Pillsbury, J. H.,	Sept. 24, 1896,	Oct. 22, 1896,
Franklin, .	1896	Wood, G. W.,	Wood, G. W.,	Aug. 2, 1895,	Sept. 4, 1896,
Worcester, .	1895	Cutter, F. P.,	Cutter, F. P.,	July 9, 1896,	Aug. 17, 1896,
Worcester, .	1896	Cutter, F. P.,	Cutter, F. P.,	Aug. 8, 1895,	June 17, 1896,
Bristol, .	1895	Keene, T. M.,	Keene, T. M.,	Aug. 13, 1896,	Sept. 1, 1896,
Bristol, .	1895	Harkness, G.,	Harkness, G.,	Aug. 2, 1895,	July 20, 1896,
Bristol, .	1895	Welton, C. A.,	Welton, C. A.,	Aug. 2, 1895,	Aug. 29, 1896,
Bristol, .	1896	Keene, T. M.,	Keene, T. M.,	Aug. 27, 1896,	July 20, 1896,
Bristol, .	1896	Harkness, G.,	Harkness, G.,	Aug. 27, 1896,	Aug. 29, 1896,
Bristol, .	1896	Welton, C. A.,	Welton, C. A.,	Aug. 27, 1896,	Sept. 9, 1896,
Gloucester, .	1895	Ruggles, E. F.,	Ruggles, E. F.,	Oct. 12, 1896,	Dec. 3, 1896,
Gloucester, .	1895	King, G. H.,	King, G. H.,	Aug. 22, 1895,	Oct. 22, 1896,
Bristol, .	1896	King, G. H.,	King, G. H.,	July 16, 1896,	Sept. 14, 1896,
Bristol, .	1895	Joyner, F. H.,	Joyner, F. H.,	Oct. 8, 1896,	Dec. 2, 1896,
Barnstable, .					
Taunton, .					
South Hadley, .					
Truro, .					

TABLE SHOWING TOWNS AND CITIES IN WHICH WORK HAS BEEN DONE, ETC. — *Concluded.*

TOWN OR CITY.	County.	Lay-out.	Resident Engineer.	Date of Contract.	Date of Beginning.	Date of Ending.
Tyngsborough,	Middlesex,	1895	Winslow, D. H.,	Aug. 15, 1895.	June 4, 1896.	Aug. 27, 1896.
Tyngsborough,	Middlesex,	1896	Peabody, W. W.,	Aug. 27, 1896.	Oct. 19, 1896.	Dec. 18, 1896.
Walpole,	Middlesex,	1895	Dadley, A. D.,	Aug. 19, 1896.	Sept. 12, 1896.	Dec. 5, 1896.
Wareham,	Plymouth,	1896	Ruggles, E. F.,	July 6, 1896.	July 22, 1896.	Oct. 10, 1896.
Warren,	Worcester,	1896	McLeod, T. M.,	Aug. 19, 1896.	Sept. 23, 1896.	Dec. 12, 1896.
Watertown,	Middlesex,	1895	Hammersley, W. P.,	Aug. 8, 1895.	June 15, 1896.	Sept. 19, 1896.
Watertown,	Middlesex,	1896	Hammersley, W. P.,	Aug. 20, 1896.	Sept. 21, 1896.	Oct. 9, 1896.
Westfield,	Hampden,	1896	Joyner, F. H.,	Sept. 1, 1896.	Sept. 8, 1896.	Nov. 4, 1896.
Westminster,	Worcester,	1895	Stuart, F. M.,	July 25, 1895.	July 30, 1896.	Dec. 4, 1896.
Westminster,	Worcester,	1896	Stuart, F. M.,	Aug. 20, 1896.	Aug. 25, 1896.	Dec. 4, 1896.
West Newbury,	Essex,	1895	Wheeler, W. B.,	Sept. 5, 1895.	May 11, 1896.	May 29, 1896.
West Newbury,	Essex,	1896	Keene, T. M.,	Aug. 27, 1896.	Sept. 18, 1896.	Dec. 18, 1896.
Westport,	Bristol,	1894	Keene, T. M.,	Nov. 1, 1894.	June 8, 1896.	July 18, 1896.
Westport,	Bristol,	1895	Maynard, G. F.,	Aug. 20, 1896.	Aug. 31, 1896.	Nov. 25, 1896.
West Springfield,	Hampden,	1895	Joyner, F. H.,	Oct. 1, 1895.	July 29, 1896.	Oct. 24, 1896.
West Springfield,	Hampden,	1896	Joyner, F. H.,	Sept. 24, 1896.	Sept. 14, 1896.	Oct. 24, 1896.
West Tisbury,	Dukes,	1895	Crowell, J. H.,	June 10, 1895.	Sept. 26, 1896.	Dec. 12, 1896.
West Tisbury,	Dukes,	1896	Crowell, J. H.,	July 30, 1896.	Sept. 26, 1896.	Dec. 15, 1896.
Weymouth,	Norfolk,	1895	Manwell, E. P.,	Aug. 15, 1895.	July 24, 1896.	Aug. 18, 1896.
Weymouth,	Norfolk,	1895	Winslow, G. R.,	Aug. 15, 1895.	Oct. 30, 1896.	Nov. 11, 1896.
Weymouth,	Norfolk,	1896	Winslow, G. R.,	Aug. 13, 1896.	Sept. 4, 1896.	Nov. 21, 1896.
Whitman,	Plymouth,	1895	Sept. 5, 1895.	July 15, 1896.	Aug. 25, 1896.	Sept. 15, 1896.
Whitman,	Plymouth,	1896	Williams, C. G.,	July 6, 1896.	July 13, 1896.	Sept. 4, 1896.
Wilbraham,	Hampden,	1895	Power, E. P.,	Sept. 24, 1895.	May 4, 1896.	July 11, 1896.
Wilbraham,	Hampden,	1896	Wason, H. B.,	Aug. 19, 1896.	Sept. 7, 1896.	Oct. 31, 1896.
Williamsburg,	Hampshire,	1896	Nickerison, E.,	Aug. 20, 1896.	Sept. 28, 1896.	Nov. 20, 1896.

Williamstown,	·	·	1895	Berkshire,	·	·	1895	Murray, J. D.,	Aug. 8, 1895,	Sept. 3, 1895,	Oct. 5, 1896,
Williamstown,	·	·	1895	Berkshire,	·	·	1895	Wheeler, R. C.,	Aug. 8, 1895,	Oct. 5, 1896,	Oct. 27, 1896,
Williamstown,	·	·	1896	Berkshire,	·	·	1896	Murray, J. D.,	Aug. 13, 1896,	Sept. 3, 1896,	Oct. 5, 1896,
Williamstown,	·	·	1896	Berkshire,	·	·	1896	Wheeler, R. C.,	Aug. 13, 1896,	Oct. 5, 1896,	Nov. 27, 1896,
Worcester,	·	·	1896	Worcester,	·	·	1896	Macksey, H. V.,	July 16, 1896,	Sept. 17, 1896,	Nov. 13, 1896,
Worcester,	·	·	1896	Worcester,	·	·	1896	Grimes, M. W.,	July 16, 1896,	Nov. 12, 1896,	Dec. 26, 1896,
Yarmouth (North),	·	·	1894	Barnstable,	·	·	1894	Everett, P. H.,	Nov. 13, 1894,	April 17, 1895,	July 11, 1896,
Yarmouth (North),	·	·	1895	Barnstable,	·	·	1895	Everett, P. H.,	July 25, 1895,	April 17, 1896,	July 11, 1896,
Yarmouth (North),	·	·	1895	Barnstable,	·	·	1895	Howard, A. H.,	July 25, 1895,	July 20, 1896,	Oct. 13, 1896,
Yarmouth (North),	·	·	1896	Barnstable,	·	·	1896	Howard, A. H.,	July 6, 1896,	July 20, 1896,	Oct. 13, 1896,
Yarmouth (North),	·	·	1896	Barnstable,	·	·	1896	Litchfield, S.,	Sept. 10, 1896,	Oct. 9, 1896,	Dec. 17, 1896,
Yarmouth (South),	·	·	1895	Barnstable,	·	·	1895	Farrington, W. R.,	Aug. 22, 1895,	April 14, 1896,	July 3, 1896,
Yarmouth (South),	·	·	1895	Barnstable,	·	·	1895	Pillsbury, J. H.,	Aug. 22, 1895,	July 6, 1896,	Sept. 2, 1896,

APPENDIX F.

SHOWING THE INSTRUCTIONS GIVEN TO ASSISTANT,
DIVISION AND RESIDENT ENGINEERS, TO GUIDE
THEM IN THEIR WORK.

INSTRUCTIONS TO ASSISTANT ENGINEERS.

1. You will be assigned the work you are to perform by the Principal Assistant Engineer, and you will be subject to his instructions.
2. You will be held responsible for the accuracy of all work under your charge, and also for the conduct of your assistants when they are away from the office of the Commission.
3. Employees of this department must not enter the rooms of the executive department during office hours, unless by the direction of the Principal Assistant Engineer.

INSTRUMENTS.

4. All instruments and tools which you may take from the office must be returned in as good order as when they are taken away, reasonable wear excepted; you will notify the Principal Assistant Engineer of any defect in instruments before they leave the office, otherwise the expenses of repairing the same will be charged to your account. All instruments must be carried to and from the work, and in no case are you to send them by express or check them as baggage. You will not be allowed storage on instruments.
5. Any damage due to carelessness to an instrument is to be paid by the employee having charge of it, but the assistant in charge will be held responsible for and must report any accident, together with the name of the person accountable for it, to the Principal Assistant Engineer.

TRANSPORTATION.

6. You will be allowed transportation as follows:—
From the office to your work and return, and from one work to another.
From your hotel or boarding-house and return *once* each day *only* when the nearest part of the work is one mile or more distant

from such place of residence. This will be allowed only when it is impossible to secure a boarding place nearer the work.

No carriage hire will be allowed when a public conveyance is available.

SUBSISTENCE.

7. You are allowed subsistence under the following-described circumstances:—

From the time you leave Boston until you return, but only when your work requires you to remain away from Boston over night.

You will not be allowed subsistence when the cost of transportation from Boston and return is less than the cost of subsistence, provided, however, you can reach your work at or before 9 A.M., and will not be obliged to leave it before 5 P.M.

EXPENDITURES AND BILLS.

8. On reaching the work you must secure a boarding place as near the location as possible. Due economy must be observed in contracting bills for subsistence. All unnecessary telephone and telegraph messages must be paid for by you.

9. All bills for services for yourself and your assistants must be submitted hereafter on bill heads to be furnished you on leaving the office. They are to be filled out neatly in ink, and are to show the city or town in which work has been done, the nature of the work (whether surveying, setting stakes, cross-sectioning, resetting stakes, etc.), the number of days on each part of the work, and are to be otherwise filled out in full.

The bills are to be filled out in two classes, viz., those charged against the appropriation for "engineering" and those charged against the appropriation for "construction."

"Engineering" will include original surveys, levers for profiles and cross-sections, and the first location.

"Construction" will include staking out for lines and grade, resetting stakes, and final cross-sections.

10. You are to agree as to price of stakes and their delivery at the time of ordering, and you must proceed with the work while awaiting such delivery.

11. You must have all bills for subsistence and materials furnished made out to Massachusetts Highway Commission before leaving your boarding place or hotel, and must at once approve and send them to the office.

12. Vouchers must, when possible, be obtained for all money paid, and an account must be kept of all the money and mileage used, the amounts chargeable to each piece of work to be kept together. If an advance is made by the office for your incidental

expenses you will make a return in bill form as soon as the money is expended, accompanied by the vouchers, showing for what purpose and in what city or town the money was expended. Where money is used for car fare or carriage hire you are to show between what points such expenditures have been made. You will provide for the above-noted allowable expenses of your party, and your returns will include the names of your assistants.

13. Any bills having erasures will be returned to you, as no bill will be approved by the Commission which has any erasures on it. Bills for subsistence are to show the names of all persons in the party.

14. If any neglect of the points specified above occurs your bills will be returned to you, and such omissions will probably delay the payment for a month.

USE OF MILEAGE BOOKS.

15. No mileage book furnished by the Commission is to be used for private purposes.

No mileage book is to be used for any other purpose than that designated on the book. Mileage books are classified under "engineering" and "construction."

"Engineering" will include original surveys, levels for profiles and cross-sections, and the first location.

"Construction" will include staking out for lines and grade, resetting stakes, and final cross-sections.

FIELD NOTES.

16. The field notes are to be kept according to the standard system of the office, and must be complete in themselves.

17. On the completion of the work in any place the note-book must at once be returned to the office, addressed to the Principal Assistant Engineer. The note-books are not for the use of the Resident Engineers; any notes they may need you will furnish to them.

18. Separate books must be used for surveys on each road.

REQUIREMENTS IN SURVEYS.

19. (a) Surveys are to be made on a transit line, checked by repeating each angle and by taking compass readings.

The base line is to follow the approximate centre of the road.

Where defined by walls or fences you are to obtain the centre by measuring between them; where there are no visible boundary lines of the location you must, as far as possible, use the centre of the travelled way.

Where there is an existing "lay-out" you must, if possible, determine and use the centre as your base line.

You are carefully to locate all walls, fences, ditches, etc., which indicate boundaries of the road or of abutting property; also all houses within one hundred (100) feet of the line of location; also all cross streets for a distance of two hundred (200) feet from the line of location.

At each fifty (50) feet on the base line, and at each cross street or driveway, elevations are to be taken at the station, at each side of the location, and at such other points as may be needed to plot a true and accurate profile of the road. Elevations must also be taken of the ground at the front corners of buildings, and of the bottoms of sills of buildings where the same are within fifty (50) feet of the location.

(b) All existing culverts and drains are to be located; the size and condition noted; elevations taken at both ends and also elevations to show the bed of the stream for fifty (50) feet each side of the location. Where, in your opinion, new culverts may be needed you will indicate their proposed location and size.

(c) Locate all bridges; give the dimensions of the openings; the nature of construction; measurements and conditions of the abutments and structure; height of stream at time of freshets; direction of flow of stream and elevations on bed of stream at each end of the bridge for a distance of fifty (50) feet from each side. Give the approximate area of the watershed and note whether there are indications that the water ever overflows the road.

(d) Locate gutters, curbing, catch-basins, and trees of value as shade trees.

(e) The following information is also to be given, fully and concisely:—

Quality and nature of the materials at each station.

The most advantageous location for a crushing plant.

Available places for water supply for roller and watering cart.

Distance in feet to the nearest side track where stone might be delivered by rail, giving name of railroad.

Location of gravel pit or pits, with samples of the gravel, which are to be properly marked and sent to the office.

Where stone for culverts and for cobble-stone gutters may be obtained.

Description of field stone in vicinity of the road.

Location of telegraph, telephone and other poles.

Price of laborers, and of single and double teams.

Cost of fencing material, rails, posts, etc.

Where guard rails, telford, cobble-stone gutters, side drains,

etc., are needed note these facts, with statement of quantities sufficiently accurate for an estimate.

The statements as above required are to be put in the note-book on the pages immediately following the survey notes.

INSTRUCTIONS TO DIVISION ENGINEERS.

1. You will be assigned the work you are to perform by the Chief Engineer, and be subject to his instructions.

2. On being assigned to a division your permanent residence will be chosen, as far as may be, so as to enable you to reach all parts of your work in the most economical and convenient manner.

You will be allowed your necessary travelling expenses from the office to your permanent residence and return *once*, and in addition to this as often as you may be required to report to the office.

You will be allowed your transportation from your permanent residence to and return from each piece of work in your division as often as may be necessary to exercise a proper supervision.

You will pay your own subsistence while at your permanent residence.

You will be allowed subsistence when you report to the office, and also when away from your permanent residence on tours of inspection.

You will return to your permanent residence each night except when the cost of transportation will exceed the cost of lodging and subsistence.

No carriage hire will be allowed when a public conveyance is available.

3. It will be your duty to see that each Resident Engineer in your division shall properly inspect the work done on the contract under his charge, and you will be held responsible for all such work.

4. When the Resident Engineer on any work in your division notifies you that he is ready to begin work, you will, as soon as possible, meet him on the work, and in company with him examine the grade stakes, compare the marks on them with the profile, and report in writing to the Chief Engineer any discrepancy.

You will also advise with the Resident Engineer on the selection of material which the contractor proposes to furnish.

You will remain on the work until you are satisfied that the Resident Engineer fully understands how he is to proceed with the construction of the road.

5. When the road-bed of any road in your division is graded and shaped ready to receive broken stone or telfording, you will be on hand ready to advise with the Resident Engineer as to the proper manner of proceeding in order to obtain the best results.

6. You will inspect each and every road in your division at least once each week, and oftener if possible, and report daily to the Chief Engineer, in writing, the condition of the roads inspected and whether the work is progressing satisfactorily. Your report will note any interruption in the work, together with the cause of such interruption. You will inspect the different books of the Resident Engineer and see that they are kept in a proper manner.

7. You are not in any manner to interfere in municipal affairs, or express opinions concerning such matters. You are to see that the work is done according to the contract and specifications, supplemented by the orders of the Chief Engineer. The hours of work and the wages paid by the contractors are matters for their determination. Use tact and discretion in your intercourse with municipal officials, and remember that your services are paid for by the Commission to secure the best work, and otherwise to guard the interests of the Commonwealth. Do not overstep your authority. Give all necessary information freely to those in charge of the work for the contractor. Criticisms of the contractor, the Board or its servants must not be made. You must not give any information as to the actual cost of the work; such information can come only through the office. You are at liberty to explain the methods employed by the State.

8. You must make out and approve all bills for transportation and subsistence to the Massachusetts Highway Commission, together with your salary bill, and send to the office on or before the twentieth day of each month.

9. Vouchers must, when possible, be obtained for all money paid, and an account must be kept of all money and mileage used, the amount chargeable to each piece of work to be kept together. You will pay your incidental expenses and make a return in bill form, weekly, of the money so expended, accompanied by the vouchers, showing for what purpose and in what city or town the money was expended. Where money has been used for car fare or carriage hire you are to show between what points such expenditures have been made.

10. No bill will be approved by the Commission which has any erasures on it. Any bill having erasures will be returned to you.

11. No mileage book furnished by the Commission is to be used for private purposes.

12. When in your opinion any work not included in the con-

tract is necessary, you must notify the Chief Engineer, in writing, of the fact, setting forth the manner and limits of such work, and await his written order.

13. You are required to pay for any unnecessary telephone or telegraphic charges.

14. If any neglect of the above-specified points occurs, your bills will be returned to you, and such omissions will probably delay the payment for a month.

15. On leaving the office you will see that you are provided with the following supplies, to be used by you, the same to be returned in good order when the work is completed:—

- (a) 1 steel tape, 100 feet long.
- (b) 1 cloth tape, 50 feet long.
- (c) 1 steel scale (40-80).
- (d) 1 sketch book.
- (e) Copy of Instructions to Resident Engineers.
- (f) Reports, paper and envelopes.

INSTRUCTIONS TO RESIDENT ENGINEERS.

1. On receiving notice that you have been appointed to serve as Resident Engineer you will at once report to the general office, 15 Court Square, Boston. On receiving instructions from the Chief Engineer you will immediately proceed to your station by the most direct route, and there remain until recalled or ordered elsewhere. Your transportation will be allowed once each way from the office to your station. If ordered to the office or any other place during the progress of the work the necessary transportation will also be allowed. No carriage hire will be allowed where there is any available public conveyance. All communications in regard to the work are to be addressed to the Chief Engineer.

When required by the following rules to send a written communication to the contractor you must retain a copy thereof and also immediately send a copy to the Chief Engineer, referring to the section of the rules under which you are acting.

2. On reaching your station you must secure a boarding-place as near to the work as possible. You will bear the cost of your own board and furnish your own transportation from your boarding place to and from the work.

You will at once report the location of your boarding-place, the

name of the person with whom you board, your exact post-office address and the name of the freight station nearest the work.

3. You must then make a careful study of the lay-out and grades, and be sure that you thoroughly understand the marks on the stakes with reference to both lines and grades. Any apparent discrepancy between the lines or grades as indicated on the plans or profiles and the marks on the stakes must be immediately reported in writing.

4. You will then notify the contractor, in writing, that you are ready to begin the work.

5. You will also confer with the contractor with reference to when and where the work is to be begun; you will examine the location and quality of the different materials which he proposes to furnish, reporting the result of your examination, and await the decision of the Chief Engineer before accepting or rejecting any material.

6. You are not to interfere with the management of the men employed on the work; if they do not perform their duties in a satisfactory manner you will at once notify the superintendent in charge.

7. As Resident Engineer you are not the superintendent for the town, city or contractor.

The contractor, whether an individual or a municipality, must furnish a competent superintendent to take charge of the work; if this is not done you will at once report to the Chief Engineer.

You are expected to make yourself as useful as possible in furthering the work, but it is to be distinctly understood by the Commission and contractor that any advice you may give as to the management of the men and teams, or as to the purchase of material, shall not in any way be held as an act of the Commission.

8. You are to give the contractor the lines and grades required in the work. The red line on the profile is the accepted grade of the centre of the finished road, and should correspond with the marks on the stakes.

9. If the grade stakes are displaced at any time you will, unless you can properly replace them, at once notify the office.

If the stakes are broken off or displaced through carelessness on the part of employees of the contractor, he must at once be notified in writing that they are to be replaced at his expense.

10. You will see that the requirements of the contract and specifications are in each instance carried out in every detail. On the discovery of any violations of either the contract or specifications a written notice must be served on the superintendent for the contractor, and a copy thereof sent to this office without delay. If

matters come up that you think should be considered, call the attention of the Chief Engineer to them the next time he visits the work, or write him fully concerning them, and be guided by the instructions received. Notify the Chief Engineer and the contractor, in writing, when the work is not being done to the best advantage by the contractor.

11. No order which varies from the regular printed specifications shall be accepted by you unless the order is in writing and signed by the Chief Engineer. *You are to send a copy of such order to the office at once.*

12. When in your opinion any work not included in the contract is necessary, you must notify the Chief Engineer, in writing, of the fact, setting forth the manner and limits of such work, and await his written order. If the Chief Engineer reports favorably on your suggestion, you will immediately serve a copy of his letter on the contractor. You must at once report the date and time of receiving such notice.

13. At no time during the progress of the work are you to leave it, except in cases of absolute necessity, without written permission from the Chief Engineer. All reports are to be made up at such times as the work is not in progress on account of storms or other interruptions.

14. You are to secure all necessary data, while on the work, for the plotting of the office plan and profile on your return; also all data concerning culverts, catch-basins, side drains, telford, guard rail or other fencing, the location of macadam, telford, cobble gutters and all other features which should properly be shown on such plan and profile to give a complete record of all work done.

15. Do not in any manner interfere in municipal affairs or express opinions concerning such matters. You are to see that the work is done according to the contract and specifications, supplemented by your instructions and the orders of the Chief Engineer. The hours of work and wages paid by the contractors are matters for their determination. Use tact and discretion in your intercourse with municipal officials, and remember that your services are paid for by the Commission to secure the best work and otherwise to guard the interests of the Commonwealth. Do not overstep your authority. Give all necessary information freely to those in charge of the work for the contractor. Criticisms of the contractor, the Board or of its servants must not be made.

You must not give any information as to the actual cost of the work; such information can only come through the office. You are at liberty to explain the methods employed by the State.

16. Blank orders on the State Treasurer for wages due will be sent with monthly estimate sheets; these orders are not to be sent to the office of the State Treasurer until the first day of each month.

17. Your salary account must be sent to this office so as to be received before the twentieth day of each month. All bills containing erasures will be returned to you.

18. No mileage book furnished by the Commission is to be used for private purposes.

19. You will be required to pay any unnecessary telegraph or telephone charges.

20. You are to keep an accurate account of all the work done on the road; also to ascertain the exact cost of doing it, whether performed by the contractor directly or by a sub-contractor; this is necessary in order to afford a basis for future contracts. It is for the purpose of collecting and entering this information in convenient form that the daily record book is supplied. In order to get this information and to see that the work is properly conducted, you must remain on the road whenever work is in progress. All the blanks marked with a star in your daily report book should have the proper entry made in ink, and great care should be taken to have each item as accurately stated as possible, without repetition of the same matter under different heads. All the blanks on the first printed page headed "prices paid by town — contractor for labor" are to be filled in. If anything appears during the work which is not provided for in the record book, you are to use the blank spaces. *A complete record of all work must be kept.*

DAILY REPORTS.

21. Daily report cards will be supplied, and one must be sent to this office daily, properly filled out, whether work is done on your section or not.

WEEKLY REPORTS.

22. On the weekly report forms, which will be supplied, you will fill with black india ink between the parallel lines opposite the various items of construction, and under the stations as shown at top of sheet, the length completed at the end of the week. You will also fill out the column concerning quantities as near as possible; also all time relating to extra work.

Under "remarks" you will state facts concerning the progress of the work, such as delays caused by the weather, want of laborers, lack of stone, breaking of machinery, etc.

The spaces between the parallel lines are to be completely filled

in when the work is completed between the stations indicated. When the work is only partly done, show between what stations work has been commenced by partially filling in the spaces above mentioned.

MONTHLY ESTIMATES.

23. Each month an estimate sheet will be sent you for your return of the quantities moved during the month. A sufficient number of sheets will be sent to enable you to make the estimate in triplicate, all of which will be sent to the office. The "quantities previously estimated" column will show the quantities paid for. The figures in this column will be entered at the office, and are not to be changed by you. If they appear to you to be incorrect, write to the office for particulars. The "quantities of this estimate" column is to show the quantities to be paid for on the bill prepared by you for the month's work. The "total quantities estimated to date" column will of course show the total of the other two columns. Each sheet is to have your signature attached to it and is to be otherwise fully filled out. A copy of the bill as approved by the Board will be sent you each month, and a similar copy will be sent to the contractor.

24. On leaving the office for the work you will see that you are supplied with the following articles, to be used by you; these are, with the exception of expended stationery, to be returned to the office in good order when the work is completed, viz. : —

- (a) 1 steel tape, 100 feet long.
- (b) 1 cloth tape, 50 feet long.
- (c) 2 plumb bobs.
- (d) 1 steel scale (40-80).
- (e) 1 daily record book (red cover).
- (f) 1 sketch book (black cover).
- (g) 1 calculation book.
- (h) 1 copy of contract and specifications.
- (i) A lot of weekly reports, paper and envelopes.
- (j) Certificates for stone delivered on road.
- (k) Plans and profile, and cross-sections of road.
- (l) A "quantity sheet," showing amount of material to be moved.

25. All books supplied to Resident Engineer must at all times be open to the inspection of the Chief Engineer or his authorized assistants. Resident Engineers will be held responsible for all articles supplied to them from this office, and will be required to give a receipt for them.

DETAILS OF THE WORK.

Excavation.

26. In all excavation, as the work progresses, you will have the slopes and surfaces completed so that the quantities can be taken from the cross-sections. In embankment, if there is a surplus of material, widen uniformly on each side and make the slope two (2) to one (1) or less. If there is a deficiency of material after making all excavations, the material for embankments is to be obtained by widening excavations, where the width of roadway will permit; otherwise from borrow pits, previously cross-sectioned, as directed by the Chief Engineer or some person duly authorized by him. The borrow pits are to be paid for by the contractor. The material taken from them must be satisfactory to the Engineer. If separate prices are made in the contract for sand, gravel, hard-pan or clay excavation, you are to ascertain accurately and record the quantity of each.

27. Material taken from borrow pits and used in embankment is to be allowed for once only at the excavation price.

28. For excavation required in the case of culverts, retaining walls or telford separate entries of the quantities must be made, as such excavation is not included in the statement of quantities furnished you on leaving the office. This excavation is to be paid for at the regular contract price.

29. Excavation for cobble gutters, pipe culverts or side drains is not to be allowed, as the cost is included in the price allowed for that class of work. Great care should be taken that such quantities are not included in earth excavation. In case ledge is met with, the regular price for ledge excavation is to be allowed.

30. Notes of all excavations not included in the cross-sections must be kept in the sketch book, and data for plotting these sections must be sent to the office. All calculations must be made in the book provided for that purpose, and the computations kept in a systematic manner.

31. All extra excavation caused by error of Resident or Locating Engineer must be allowed to the contractor, and report of it sent to the Chief Engineer immediately on the discovery of such error. Any failure to report an error of this kind will be considered sufficient cause for immediate discharge.

32. All trees, excepting those to be reserved for shade, and all stumps and brush lying between the tops of new slopes of excavation and bottom of slopes in embankments must be removed by the contractor when ordered so to do by the Engineer, and the

work is not to be considered as an extra, being included in the contract price for excavation.

33. The contractors are required to smooth off slopes of both excavation and embankment, and to remove all rubbish. Payments for finishing between limits are to include only work between the foot of slopes or top of cuts and the line of location.

Culverts.

34. In culverts you will have suitable stone used; the foundations to be two and one-half ($2\frac{1}{2}$) feet or more below the natural surface, breaking joints one (1) foot; no spalls are to be allowed on the face. The ends of culverts shall be laid parallel to the centre line of broken stone. The end, or face, walls shall be of coursed rubble, breaking joints at least one (1) foot, and have no "pinners" on the face, joints not to exceed one (1) inch. The wall shall be capped with covering stones one (1) foot in thickness, at least two (2) feet in width and long enough to rest on the wall at least one (1) foot on each side. The culverts are to be sufficiently long to extend at least to the end of the slopes. In rebuilding culverts the ends are to be without spalls. The other parts of the work which are not exposed are to be of any split quarry stone, or that split from boulders and laid true to line. All face masonry, or culvert ends, are to be paid for at the price allowed for rubble masonry laid in cement, as stated in contract. Face masonry is to be measured two (2) feet back from the face. All necessary excavation met with in the construction of stone culverts is to be regarded as a "pay" quantity, and the cost and amount must be recorded in such a manner as to be readily figured separately from the cost and quantity of rubble masonry. All masonry is to be measured in accordance with the sections.

Gravel.

35. You will use gravel for surfacing the roadbed under telford; also for surfacing the sub-grade where the natural soil is clayey, loamy, or where ordered under other conditions by the Chief Engineer. The gravel must be practically free from sand and clay. It is not to be used for making embankment unless the contractor will furnish it at the regular excavation prices. Gravel pits must be cross-sectioned and quantities estimated in the bank. All gravel found within the limits of location is to be paid for as excavation only. Gravel used in the construction of drains, or broken stone used for the same purpose, is not to be considered a "pay" quantity; the cost of all incidentals in such work is included in the price paid for it. Unless suitable gravel can be pro-

vided, the shoulders will be built of the best selected material from the excavation, unless other otherwise ordered by the Chief Engineer.

Shaping.

36. By shaping is meant the preparation of the roadbed for the broken stone. It is paid for by the square yard, and in measuring, the full width covered by the broken stone and shoulders is to be reckoned.

Broken Stone.

37. State highways are divided as follows with reference to the broken stone (sizes given are in inches) :—

a. All trap rock. Bottom course to be $1\frac{1}{4}$ to $2\frac{1}{2}$; top course to be $\frac{1}{2}$ to $1\frac{1}{4}$.

b. All trap rock. Both courses to be $1\frac{1}{4}$ to $2\frac{1}{2}$.

c. Local stone other than trap. Bottom course to be $1\frac{1}{4}$ to $2\frac{1}{2}$; top course to be $\frac{1}{2}$ to $1\frac{1}{4}$.

d. Local stone other than trap. Both courses to be $\frac{1}{2}$ to $2\frac{1}{2}$.

e. Bottom course of local stone other than trap $\frac{1}{2}$ to $2\frac{1}{2}$; top course of trap rock $\frac{1}{2}$ to $1\frac{1}{4}$.

f. Bottom course of local stone other than trap $\frac{1}{2}$ to $2\frac{1}{2}$; top course of trap rock $1\frac{1}{4}$ to $2\frac{1}{2}$.

g. All trap rock. Bottom course to be $\frac{1}{2}$ to $1\frac{1}{4}$; top course to be $1\frac{1}{4}$ to $2\frac{1}{2}$.

h. Local stone other than trap. Bottom course to be $\frac{1}{2}$ to $2\frac{1}{2}$; top course to be $1\frac{1}{4}$ to $2\frac{1}{2}$.

38. Before leaving to take charge of any particular work you will be instructed by the Chief Engineer in which of the above-mentioned divisions your road belongs.

39. The above-noted list does not include the screenings, or binder, course; this will be described in the contract and specifications.

40. You must carefully examine all stone which the contractor furnishes, and insist upon its conforming, both in quality and sizes, with the requirements of the classification above described.

41. When "local stone other than trap" is used you must not allow any soft or disintegrated rock to go upon the road; all such rock must be rejected before breaking. If the contractor fails to remove such rock, immediately report the fact in writing to the Chief Engineer.

42. All broken stone must be screened, and any broken stone which will not pass through a two and one-half ($2\frac{1}{2}$) inch ring, or is more than two and one-half ($2\frac{1}{2}$) inches in its largest diameter, must be rebroken or rejected.

43. In every case the screenings used on the surface as a binder course must be of the same kind of stone as the top course of the road.

44. Great care must be taken at any stage of the work to prevent any waste of broken stone. You must keep careful watch at the crusher, at the cars, on the shoulders or at any dump to prevent such waste. You must see that the scales are adjusted each day.

45. All broken stone used in any drain or gutter, or on any part of the road except the hardened way, must be deducted from the estimate of broken stone used in building, and a report made of the quantity so used.

46. *Class a.*—All trap rock. Bottom course $1\frac{1}{4}$ to $2\frac{1}{2}$; top course $\frac{1}{2}$ to $1\frac{1}{4}$.

Where the traffic is not very heavy and trap rock is used it must be spread in two courses, viz., the bottom course of sizes varying from one and one-quarter ($1\frac{1}{4}$) to two and one-half ($2\frac{1}{2}$) inches; the top course in sizes varying from one-half ($\frac{1}{2}$) to one and one-quarter ($1\frac{1}{4}$) inches.

Where the foundation is good and no telfording is required, the bottom course is to be four (4) inches thick at the centre and three (3) inches thick at the sides, after rolling. The top course is to be two (2) inches thick after rolling.

Where telford is used, the bottom course is to be two and one-half ($2\frac{1}{2}$) inches thick after rolling; the top course one and one-half ($1\frac{1}{2}$) inches thick after rolling.

The binder course in all cases must only be sufficient to cover the coarser stone after it has been rolled.

Each course of broken stone must be rolled separately and evened up with stone of the same sizes as have been used in that particular course.

47. *Class b.*—All trap rock. Both courses $1\frac{1}{4}$ to $2\frac{1}{2}$.

Where the traffic is heavy and trap rock is purchased by the contractor and imported, it must be spread in two courses where there is no telfording and in one course where a telford foundation is used, and in sizes varying from one and one-quarter ($1\frac{1}{4}$) to two and one-half ($2\frac{1}{2}$) inches in diameter.

Where the foundation is good and no telfording is used the bottom course is to be three and one-half ($3\frac{1}{2}$) inches thick in the centre and two and one-half ($2\frac{1}{2}$) inches thick at the sides, after rolling. The top course is to be two and one-half ($2\frac{1}{2}$) inches thick after rolling.

Where telfording is used, the broken stone is to be four (4) inches thick after rolling.

The binder course in all cases is to be sufficient only to cover the coarser stone after it has been rolled.

Where there is no telfording, each course of broken stone is to be rolled separately and evened up.

Where telfording is used, the two courses of stone are to be rolled as one course and evened up.

48. *Class c.*—Local stone other than trap. Bottom course $1\frac{1}{4}$ to $2\frac{1}{2}$; top course $\frac{1}{2}$ to $1\frac{1}{4}$.

Where the travel is comparatively light and the broken stone is of fairly good quality, it must be spread in two courses, viz., the bottom course of sizes varying from one and one-quarter ($1\frac{1}{4}$) to two and one-half ($2\frac{1}{2}$) inches; the top course in sizes varying from one-half ($\frac{1}{2}$) to one and one-quarter ($1\frac{1}{4}$) inches.

Where the foundation is good and no telfording is required, the bottom course is to be four (4) inches thick at the centre and three (3) inches thick at the sides, after rolling; the top course two (2) inches thick after rolling.

Where telfording is used, the bottom course is to be two and one-half ($2\frac{1}{2}$) inches thick after rolling; the top course one and one-half ($1\frac{1}{2}$) inches thick after rolling.

The binder course is to be sufficient only to cover the coarser stone after it has been rolled.

Each course of broken stone is to be separately rolled and evened up with stone of the same sizes as have been used on that particular course.

49. *Class d.*—Local stone other than trap. Both courses $\frac{1}{2}$ to $2\frac{1}{2}$.

Where the travel is not very heavy and the local broken stone is of fairly good quality, it must be spread in two courses where there is no telfording and in one course where telfording foundation is used, and in sizes varying from one-half ($\frac{1}{2}$) to two and one-half ($2\frac{1}{2}$) inches.

Where the foundation is good and no telfording is required, the bottom course is to be three and one-half ($3\frac{1}{2}$) inches thick in the centre and two and one-half ($2\frac{1}{2}$) inches thick at the sides, after rolling. The top course is to be two and one-half ($2\frac{1}{2}$) inches thick after rolling.

Where telfording is used, the broken stone is to be four (4) inches thick after rolling.

The binder course in all cases must be sufficient only to cover the coarser stone after it has been rolled.

Each course of broken stone is to be rolled separately and evened up with stone of the same sizes as have been used in that particular course.

The screen must be arranged without any one and one-quarter ($1\frac{1}{4}$) inch opening; all the stone from one-half ($\frac{1}{2}$) to two and one-half ($2\frac{1}{2}$) inches must pass directly to one bin, and be thoroughly mixed. You must not allow the broken stone which is not thoroughly mixed to be used.

50. *Class e.*—Bottom course local stone other than trap $\frac{1}{2}$ to $2\frac{1}{2}$; top course trap rock $\frac{1}{2}$ to $1\frac{1}{4}$.

Where the travel is not very heavy, the supply of broken stone cheap but of poor quality, and trap rock can be imported at a reasonable cost, the broken stone must be spread in two courses, viz., the bottom course of local stone varying in size from one-half ($\frac{1}{2}$) to two and one-half ($2\frac{1}{2}$) inches; the top course of trap rock in sizes varying from one-half ($\frac{1}{2}$) to one and one-quarter ($1\frac{1}{4}$) inches.

Where the foundation is good and no telfording is required, the bottom course is to be of local stone three (3) inches thick in the centre and two and one-half ($2\frac{1}{2}$) inches thick at the sides, after rolling. The top course is to be of trap rock three (3) inches thick at the centre and two and one-half ($2\frac{1}{2}$) inches thick at the sides, after rolling.

Where telfording is used, local broken stone is to be spread and rolled to bring the crown up to within three (3) inches of the finished grade and cross-section. Trap rock varying in size from one-half ($\frac{1}{2}$) to one and one-quarter ($1\frac{1}{4}$) inches must then be spread, to give a thickness of three (3) inches after rolling.

The binder course in all cases must be sufficient only to cover the coarser stone after it has been rolled.

Each course of broken stone must be rolled separately and evened up with stone of the same sizes as have been used in that particular course.

51. *Class f.*—Bottom course local stone other than trap $\frac{1}{2}$ to $2\frac{1}{2}$; top course trap rock $1\frac{1}{4}$ to $2\frac{1}{2}$.

Where the travel is heavy, the supply of local stone cheap but of poor quality, and trap rock can be imported at a reasonable cost, the broken stone must be spread in two courses, viz., the bottom course of local stone varying in size from one-half ($\frac{1}{2}$) to two and one-half ($2\frac{1}{2}$) inches; the top course of trap rock varying in size from one and one-quarter ($1\frac{1}{4}$) to two and one-half ($2\frac{1}{2}$) inches.

Where the foundation is good and no telfording is required, the bottom course is to be of local stone three (3) inches thick at the centre and two and one-half ($2\frac{1}{2}$) inches thick at the sides, after rolling. The top course is to be of trap rock three (3) inches thick at the centre and two and one-half ($2\frac{1}{2}$) inches thick at the sides, after rolling.

Where telfording is used, local broken stone is to be spread and rolled to bring the crown up to within three (3) inches of the finished grade and cross-section. Trap rock varying in size from one and one-quarter ($1\frac{1}{4}$) to two and one-half ($2\frac{1}{2}$) inches is then to be spread to give a thickness of three (3) inches after rolling.

The binder courses in all cases must be sufficient only to cover the coarser stone after it has been rolled.

Each course of broken stone must be separately rolled and evened up with stone of the same sizes as have been used in that particular course.

52. *Class g.*—All trap rock. Bottom course $\frac{1}{2}$ to $1\frac{1}{4}$; top course $1\frac{1}{4}$ to $2\frac{1}{2}$.

Where the travel is heavy, and the trap rock is broken by the contractor, or is purchased at a local crusher, it must be spread in two courses, viz., the bottom course of sizes varying from one-half ($\frac{1}{2}$) to one and one-quarter ($1\frac{1}{4}$) inches; the top course varying in size from one and one-quarter ($1\frac{1}{4}$) to two and one-half ($2\frac{1}{2}$) inches.

Where the foundation is good and no telfording is required, the bottom course is to be two and one-half ($2\frac{1}{2}$) inches thick, after rolling.

The top course is to be three and one-half ($3\frac{1}{2}$) inches thick at the centre and two and one-half ($2\frac{1}{2}$) inches thick at the sides, after rolling.

In case there is a surplus or deficiency of the one-half ($\frac{1}{2}$) to one and one-quarter ($1\frac{1}{4}$) inch sizes, you will increase or diminish the thickness of the bottom course so as to use all of the product of the crusher, and correspondingly increase or diminish the thickness of the top course.

Where telfording is used, broken stone varying from one-half ($\frac{1}{2}$) to one and one-quarter ($1\frac{1}{4}$) inches is to be spread and rolled to bring the crown up to within three (3) inches of the finished grade and cross-section.

The binder course in all cases must be sufficient only to cover the coarser stone after it has been rolled.

Where there is no telfording, each course of broken stone is to be separately rolled and evened up with stone of the same sizes as have been used in that particular course.

Where telfording is used, the two courses of broken stone are to be rolled as one course, and the top course is to be evened up with stone varying from one and one-quarter ($1\frac{1}{4}$) to two and one-half ($2\frac{1}{2}$) inches.

53. *Class h.*—Local stone other than trap. Bottom course $\frac{1}{2}$ to $2\frac{1}{2}$; top course $1\frac{1}{4}$ to $2\frac{1}{2}$.

Where the travel is heavy, and the local broken stone is not of the best quality, and the cost of importing stone would be too great to allow of its use, the broken stone must be spread in two courses, viz., the bottom course of sizes varying from one-half ($\frac{1}{2}$) to one and one-quarter ($1\frac{1}{4}$) inches; the top course varying in size from one and one-quarter ($1\frac{1}{4}$) to two and one-half ($2\frac{1}{2}$) inches.

Where the foundation is good and no telfording is required, the bottom course is to be two and one-half ($2\frac{1}{2}$) inches thick after rolling. The top course will be three and one-half ($3\frac{1}{2}$) inches in thickness at the centre and two and one-half ($2\frac{1}{2}$) inches thick at the sides, after rolling.

In case you find you will have a surplus of the one-half ($\frac{1}{2}$) to one and one-quarter ($1\frac{1}{4}$) inch sizes, you will immediately increase the thickness of the bottom course so as to use all the product of the crusher, and correspondingly decrease the thickness of the top course.

Where telfording is used, the broken stone varying in sizes from one-half ($\frac{1}{2}$) to one and one-quarter ($1\frac{1}{4}$) inches is to be spread to a depth not exceeding two (2) inches, and this covered with the broken stone varying in size from one and one-quarter ($1\frac{1}{4}$) to two and one-half ($2\frac{1}{2}$) inches, to give a thickness of four (4) inches of broken stone after rolling.

The binder course in all cases must be sufficient only to cover the coarser stone after it is rolled.

Where there is no telfording, each course of broken stone must be separately rolled and evened up with stone of the same sizes as have been used in that particular course.

Where telfording is used, the two courses of broken stone are to be rolled as one course, and the top course will be evened up with stone varying in size from one and one-quarter ($1\frac{1}{4}$) to two and one-half ($2\frac{1}{2}$) inches.

Rolling.

54. When possible roll the sub-grade with a steam roller.
55. If the sub-grade is too sandy to roll, cover with coarse gravel laid on to a depth of three (3) inches, or as much more as may be needed to give a good foundation.
56. Fill any depressions with the same material until the surface is true and even.
57. All broken stone must be rolled in screened layers.
58. After spreading the first course of broken stone, begin rolling at the sides, and continue this by running ahead so as to allow from two (2) to five (5) inches of the driving wheel to pass over the shoulder, and backward with the outer edge of the driving

wheel from five (5) to ten (10) inches inside the edge of the broken stone. Roll until the stone ceases to "wave" in front of the wheels, and until it seems firm under foot as you walk over it. Next begin on the other side and roll in the same manner. Then work toward the centre until the stone is rolled. Roll each layer of stone in the same manner.

59. If the road shows a wavy motion after passing the roller over it three, four or more times, it may indicate too much moisture in the sub-grade. If, on examination, you find this to be true, stop rolling and move ahead, allowing time for the sub-grade to dry out.

60. With some coarse, hard granitic rocks it has been noted that after the roller passes over them a few times they begin to "crawl" and the sharp edges break off. A slight sprinkling of sand or stone screenings, or water, may prevent this. Try one after another of these means, until the work progresses to your satisfaction. You must not expect to prevent the stone from shaking as you walk over it, but you need to continue the rolling until the fragments of stone adjacent to where the foot presses do not move as you walk. Most of the rolling must be done before you spread the screenings. After spreading the screenings, water and roll until the mud flushes to the surface. You cannot expect to prevent the stone from kicking out if the teams pass over the road. Keep watch, and in a few days have the roller pass once or twice over the road, after watering, until the loose stones are pressed down out of sight.

61. Before spreading any broken stone, great care must be taken to have the sub-grade carefully shaped and thoroughly compacted.

62. All shoulders must be shaped and left sufficiently high to roll to the proper grade before any broken stone is spread on the road.

63. In the case of heavy fills you must not run the roller to the edge of the shoulders unless the fill has had time to settle. Work out slowly on this kind of work.

64. In every case the screenings used on the surface as a binder course must be of the same material as the top course of the road.

65. Excepting where it may be needed to compact hard, granitic rocks, as before referred to, you will use water only on the top, or binder, course.

66. You will wet this binder course thoroughly before rolling, but not to the extent of saturating the foundation. You will get better results and prevent the screenings from being picked up by

the wheels of the roller if you apply the water and allow it to settle down below the top surface before passing the roller over it. Too much water, or too little, will give trouble by causing the surface to be picked up.

67. You must not under any conditions roll the screenings while dry.

68. You must not under any conditions allow teams to pass over the road after the screenings are spread and before they are rolled.

69. In case of a deficiency in the water supply, you may have the screenings spread and await a rain before rolling; but in such case the road must be entirely closed to travel, and the rolling must be begun as soon as the road is wet and continue until the section covered with screenings is thoroughly compacted. In such cases it may be necessary to operate the roller day and night, and you must insist on this being done. In case you meet with any difficulty in compacting the stone, and fail to understand the cause, report immediately in writing to the office.

70. You are to keep a correct and accurate account of the cost of rolling both the sub-grade and the broken stone which is placed on the road. If the roller is owned by the municipality or contractor, you are to show the number of hours actually employed in rolling the sub-grade and in rolling the broken stone, the cost of engineer (this may vary, according as he is paid by the day or week), of fuel, of oil, of waste, of water and watering, and of all other expenses properly to be entered under the head of rolling. If the roller is hired by the municipality or contractor, you are to keep, in addition to the above, a record of the cost of transportation from the point of shipment to where the work is being done and the price per day paid for the use of the roller, together with the amount actually paid for the roller by the contractor or municipality. If any repairs are necessary and are made on the roller in either case, data regarding same should be obtained and noted.

Breaking, Weighing, etc.

71. When the contractor breaks the stone used on the road, you are to keep a record of the price per ton paid for the stone delivered at the crusher, the number of tons so delivered and the average length of haul. You are also to keep an account of the hours and the cost per hour of laborers, superintendent, and single and double teams employed in handling the stone from the time of delivery at the crusher until broken.

72. In addition, you are to keep an accurate account of the cost of breaking the stone, the amounts paid the engineer, the cost

of fuel, oil, waste, water or any other item properly entering into such cost, as indicated by bills paid by the contractor. If repairs are necessary to the crusher, a record of the cost of such repairs and the length of time the crusher is thereby stopped. The number of tons of each particular size of stone broken must be accurately recorded.

73. A record of the cost of handling the stone from the time it is broken until it is delivered on the road for rolling must also be kept, showing the details of the cost of "loading," "teaming," "spreading" and "supervision," and other items, if any. The sum total of all these items, added to the cost of "rolling," will give the cost of the stone delivered on the road. In cases where the stone is delivered by rail, a record of the cost of "loading" or "unloading," "teaming," "spreading" and "supervision," as well as any other important items, must be kept in the same manner as when the stone is broken locally, the cost of the stone on the road being figured by adding the cost per ton at the station to the above items and the cost of "rolling."

74. The Chief Engineer has been instructed by the Commissioners not to accept any determination of the quantity of broken stone used except upon actual weights, the weigh-master to be a sworn weigher. You will therefore ascertain if these conditions have been complied with before issuing any certificates for the stone.

75. All scales used for weighing on State highways must be legally sealed before allowing any broken stone to be weighed on them. You must see that the scales are adjusted each day.

76. In all cases, except where stone is shipped by railway, a certificate is to be given each day for all broken stone placed on the road, one slip for each size of stone used. Where the stone is thus shipped, a proper record of the weight of each car-load received and placed on the road, with date of receipt, is to be kept, the weights to be taken from paid freight bills, and duplicates of such paid bills to be secured if possible.

The slips in your stone certificate books are to be used in their order, the lowest numbered first.

Each slip is to be filled out in full, is to state the weight of stone, the size, and must be delivered by the Resident Engineer to the contractor or his authorized agent, after having been duly signed by him. The stubs accompanying the slips are to be filled out in full to agree with the slips or certificates so delivered, and on the inside of the cover at the end of each book the total weight of each kind of stone is to be placed.

When the certificates in a book are all used, the stubs are to be at once sent to the office.

These certificates are to be personally made out by the Resident Engineer, and he is to be held personally responsible for any inaccuracies which may occur in them.

77. If a weigher is employed on the road under your supervision, he is to be paid at the same rate as a laborer, but only on those days when actually engaged in the weighing of broken stone placed on the road, one-half day to be the minimum time to be charged when any work is done.

Telford.

78. Telfording will be used in all cases where the road passes over clay, or wet soil. You will make a careful study of the road, and report in writing to the Chief Engineer where in your opinion telfording is needed, giving a description of the soil, together with the general slope of the adjacent ground. In your report you will note the stations between which the telfording may be needed.

79. Where telford is to be used, you will see that the roadbed is excavated and carefully rolled, and left true and even, corresponding to the cross-section, and twelve (12) inches below the established grade of the finished work. You will then cause to be uniformly spread two (2) inches of gravel over the sub-grade. On this sub-grade you will place a foundation of stones, which may vary in size as follows: four (4) to ten (10) inches in width, six (6) to twenty (20) inches in length, five (5) to six (6) inches in depth (not more than ten (10) per cent. of the stone to less than six (6) inches in depth). The stone must be sound, and of a quality approved by the Chief Engineer.

80. The telford stones shall be placed by hand, vertically, on the broadest edges and lengthwise across the road, so as to form a close, firm pavement. They shall be bound by inserting and driving down, in all places where it is practicable, stone of proper size and shape to wedge them in their proper position. No large stone will be left with a projecting point coming nearer than four (4) inches to the finished grade and cross-section. If any such projection be found, it must be broken off to allow a clear depth of four (4) inches of broken stone.

81. The telfording shall then be rolled with a steam roller, all depressions filled with stone chips or spalls, rolled and left true and even and four (4) inches below the finished grade and cross-section. If a drain is to be put in, it must be finished after the excavation is made and before the gravel is spread.

Drains.

82. Where telfording is used, or where ground water from a side hill may work injury to the road, you will build drains.

83. If the road passes through a cut, you will place a drain on each side.

84. If the road is on a side hill, you will place a drain on the up-hill side only.

85. All drains must be carried to a proper outlet, either to a culvert, to another drain or through the bank.

86. Where it is necessary to extend a drain to an outlet beyond the section needing to be drained, you will lay the pipe with cement joints on such extension, and omit the gravel or stone in the trench.

87. Where a pipe is carried through a bank, the outlet must be protected by masonry, as provided in pipe culverts.

88. All pipe must be laid true to a line and grade, and no pipe is to be laid on a grade of less than three (3) inches in one hundred (100) feet.

89. If in laying out a drain you find the trench is likely to exceed five (5) feet in depth below the finished grade, you will immediately report the conditions in writing to the Chief Engineer.

90. The centre of the pipe in all drains will be placed twelve (12) inches outside of the line of broken stone.

91. When the grade of the finished road is three (3) inches or more to the hundred (100) feet, the bottom of the drain trench must be three and one-half ($3\frac{1}{2}$) feet below the finished surface of the road at that part of the cross-section.

92. The drain trench will be excavated to a width of twelve (12) inches at the bottom and fifteen (15) inches at the top, and should be excavated only as fast as the drain can be finished.

93. On the bottom of this trench you will place two (2) inches of gravel or broken stone which will pass through a one and one-quarter ($1\frac{1}{4}$) inch mesh and not through a one-half ($\frac{1}{2}$) inch mesh.

94. All side drain pipe will be five (5) inch salt-glazed vitrified clay pipe, with bell and spigot joint (unless stated to the contrary in the specifications).

95. The pipe is to be laid on the grade hereinbefore mentioned, with open joints and the bell end toward the rising grade.

96. Gravel or broken stone of the sizes already described will be filled about the pipe and over it for a depth of one (1) foot. This must be carefully tamped about and rammed over the pipe. The remainder of the trench is to be filled with stone which will pass through a three (3) inch and not through a one (1) inch mesh.

Great care must be taken to prevent any sand, silt or earth from getting into the pipe or the interstices of the stone in the trench.

97. The sub-grade of the road is to have a regular slope to the edge of the drain.

98. The price per linear foot includes the cost of trenching and refilling with gravel or broken stone, the cost of the pipe and laying, as well as all incidental work.

99. No allowance will be made on extra size of pipe in any drain unless the larger pipe has been ordered in writing by the Chief Engineer.

Gutters.

100. Paved gutters will be built where directed by the Chief Engineer.

101. No gutter is to be laid until after the broken stone has been rolled.

102. In no case is the roller to pass over any part of any paved gutter.

103. Gutters not exceeding four hundred (400) feet in length shall be three (3) feet wide with a shoulder one (1) foot wide and a dish of three (3) inches.

Gutters exceeding four hundred (400) feet in length shall increase the dish above this length at the rate of one (1) inch to each three hundred (300) feet.

104. All stone used in gutters shall be rounded field, bank or river stone; no flat, shaky or rotten stone shall be used.

105. The stone may on the average lay from four (4) to six (6) square yards to the ton. A cubic yard may be estimated to weigh one and one-third ($1\frac{1}{3}$) tons.

106. The larger selected stone will be laid in the gutter itself and on the edges to a true line and grade, with the largest diameters lengthwise of the road. All other stone will be laid with the longest diameters across the gutter.

107. The trench shall be excavated to a depth of twelve (12) inches below the finished grade of the gutter; gravel shall then be spread and rammed to a depth of four (4) inches. A layer of bedding sand or gravel free from stone larger than one-half ($\frac{1}{2}$) inch in diameter shall then be spread of a sufficient thickness to bring the gutter stone which are bedded in it to the proper grade and cross-section after they are thoroughly rammed.

108. Each stone is to be rammed to an unyielding foundation. The surface shall then be covered with sand or screened gravel, which must be well broomed into all joints. The stone shall then be re-rammed and the surface left true and even. Sand or screened

gravel shall then be spread over the entire surface of sufficient depth to fill all interstices.

109. The edge of the gutter toward the road shall be left one-quarter ($\frac{1}{4}$) inch below the surface of the adjoining broken stone; in no case must it project above it.

110. Any broken stone which may be disturbed during the paving of the gutter must be carefully replaced and thoroughly rammed.

111. The bank on the outside of the gutter must be sloped to the gutter, so as to have no bunches or depressions on its surface.

Finishing between Limits.

112. Finishing between limits shall include the cost of removing brush, stone and other unsightly obstructions between tops of excavation and outside limits of location, and between bottoms of slopes and outside limits of location. The smoothing of all slopes in new cuts or fills is to be done at the expense of the contractor.

Fencing used as Guard Rail.

113. Fencing shall be placed wherever necessary to protect travellers from danger. On embankments the fences shall be so placed as to leave all the width possible between them, the posts being placed parallel to the line of broken stone and to conform to finished grade, and set one (1) foot from the edge of the embankment.

114. The posts shall be straight, have all knots hewn down to face, be set with the large end in the ground after having the bottom sawed off square. Care must be taken to so distribute the different sizes that those of similar diameter shall be together. The top and hub rails must each be long enough to extend over three (3) posts, and must break joints.

115. The exposed portions of the fence shall be covered by two (2) coats of lead and oil paint of a medium slate color.

Stone Monuments.

116. Stone bounds are to be set on both sides of the location taken by the State where required; where the length of the tangent is two thousand (2,000) feet or more, bounds are to be set at intervals of one thousand (1,000) feet, and where between one thousand (1,000) and two thousand (2,000) feet, bounds are to be set one-half way between angle points.

117. In cases where the State location includes the whole width of the road, bounds are to be set with the centre of the back edge marking the angle or tangent point, the bounds to show one (1)

foot above the ground where there are no sidewalks, and where sidewalks exist bounds are to be set flush with the grade of the sidewalk. Where the State takes a limited location within the present location of the street, bounds are to be set flush with the sidewalk, the centre of the back edge marking the angle or tangent point as before.

118. Bounds are to be set at all angle points, and at points of curvature and points of tangency of all curves. Where the ground is of a clayey nature, or muck, the material is to be excavated to a proper depth, the diameter of the excavation to be not less than two (2) feet, the excavation to be refilled with gravel or sand and thoroughly tamped.

119. When the bound comes on a ledge, an iron bolt one (1) inch in diameter and eight (8) inches long, set six (6) inches into the ledge, will take the place of the stone monument. In cases where the lay-out begins or ends at the abutment of a bridge, drill holes and bolts will take the place of the stone monuments.

120. The lettered side of the bound stones is to be placed facing the centre of the street.

APPENDIX C.

The following table shows the quantities of work done from the beginning on each road, the total cost of the work and the percentage each item of the contract is of the entire cost up to Dec. 31, 1896. The column headed "Total cost of work" includes the amounts already paid and the amounts held in reserve, also the cost of engineering charged to construction, miscellaneous items of the contract and the cost of inspection.

4 bonds each build three bridge iron and harder, flight in case, weight all rising and extra culture than



X C.—Table showing the quantities of work done from the beginning on each road, the total cost of the work and the percentage each item of the contract is of the entire cost up to Dec. 31, 1896—C.



C.—Table showing the quantities of work done from the beginning on each road, the total cost of the work and the percentage each item of the contract is of the entire cost up to Dec. 31, 1891.

6. *See* P. Hirsch, *How to Read* (London, 1981); and J. R. Levin, *Reading in the Novel* (London, 1982).

• *Journal of Health Politics*

Intertidal diversity

$\approx 4\pi/3\pi^2 \approx 0.43$

$\rightarrow \mu \pi^- \pi^0 \pi^0$

800 (n)





APPENDIX G.

SHOWING LABORATORY EXPERIMENTS ON ROAD-BUILDING STONES.

The work in the Highway Commission laboratory at the Lawrence Scientific School has proceeded along the same general lines as described in last year's report.

To further systematize the work, a standard method for obtaining test specimens of stone for the laboratory, and of recording their localities, has been adopted by the commission. This method is shown by the following form, a copy of which is sent to all the resident engineers: —

DEAR SIR: — A specimen of all stone to be used for macadam on State highways must be sent to the geologist of the Board, Mr. L. W. Page.

The specimen should consist of at least thirty pounds, to be a fair representation of the stone to be supplied, to contain one piece three by four inches on one face and to be about two inches thick; the remainder of the stone to be of the *largest* size of stone coming from the crusher.

The blank form below must be filled out and placed in the accompanying envelope, which should be used as the address for the specimen.

It is desired that the stone be shipped in a burlap bag.

Very truly yours,

A. B. FLETCHER,

Clerk of the Commission.

Specimen of Stone for State Highway in the Town of

Sent , 189 .

By

Residence,

Locality from which stone comes,

Remarks:

Received , 189.

Geologist:

These forms are returned to the laboratory, filled in, and carefully filed away for reference, so that, together with the results of tests and the engineers' reports, sufficient data is furnished for a complete history of the building and maintenance of any road.

The abrasion test, which the commission considers to be of the greatest value up to the present time, has been carried out on all the specimens sent in. The results obtained from these tests are given in the accompanying table, together with the results of last

year, for convenience of comparison. The most notable feature of the results obtained this year is the decided improvement in the quality of stone sent in. It will be seen by referring to the table that several specimens have exceeded in abrasion-resisting power any previously sent in, and that the general average is considerably higher.

Sufficient time has not yet elapsed to ascertain precisely the relation between the abrasion-resisting power of the stone and the wearing quality in actual use on the roads, but the data necessary for that purpose is being collected. The long-continued experience of the French engineers, however, supports the view of the commission that the relation is very close.

Careful microscopic analyses have been made of all the rocks tested, this being necessary for determining the nature of the various rocks, and it also seemed that some relationship might be established between the structure and mineral composition of the rocks and their wearing qualities. A glance at the accompanying table will show that there is such a relation. Of the twenty-five highest results, twenty are diabases (traps), and diabases are generally acknowledged to be the best road metals. It will also be seen that there is a tendency for other varieties of rock to show a like relation in the coefficients of abrasion, and this the writer feels certain would be much more pronounced if good test specimens could always be obtained.

The specific densities of all test specimens (except when there is more than one variety of rock present) are determined, and they can be found in the accompanying table. As yet no distinct relationship can be traced between the specific densities and the wearing properties of the materials.

Hand specimens, three by four inches square, are taken from each test specimen, and they are carefully labelled and placed in a cabinet for reference.

Considerable time has been spent in the endeavor to find satisfactory methods of testing the qualities of road metals other than that ascertained by the abrasion test. The cementation test referred to in last year's report has been the subject of considerable investigation. Before the results of this test could be used with confidence, it was necessary to obtain a standard method of procedure. Before this standard could be obtained, the conduct of the material under different conditions of loading, that is, with different heights of fall of the striking hammer, had to be ascertained. This was done for a large number of stones. The relation between the number of blows required to destroy the briquette, and the height of fall of the hammer, appears from the results so far obtained to be a very simple one. In the specimens

tested, disintegration occurred after a certain amount of work had been done on the briquette, irrespective (within wide limits) of the height of fall of the hammer. The work along this line of inquiry is not yet completed, but if the above fact continues to hold true it will simplify considerably the problem in hand. The actual results so far obtained are not given here, as it is hoped to present them when the whole investigation is complete.

Another series of investigations has been begun for the purpose of determining the toughness of various kinds of road stone. By this is meant the resistance of the material to a suddenly applied load. The principal loads to which roads are subjected are of this nature. The property to be investigated is practically similar to that already being tested for in the case of cemented stone dust, only the test is carried out on the firm rock itself, and not on the binder. Consequently, a method similar to that already described for the cementing test suggested itself as appropriate. The rock to be tested was sawed into accurately shaped cubes of two centimeters (.78 of an inch) faces. These were subjected to impact, at first under a flat plunger. It was soon found, however, that this did not give the required conditions, so a rounded plunger, which exerts a kind of wedging action, was therefore substituted. The work along these lines has not proceeded far, as the labor required for cutting cubes is considerable, and has all devolved upon one person. If an appropriation were made for an assistant, work of this nature would be greatly expedited. The work so far done gives promise of valuable results. It seems to indicate that the disintegration of the cube does not occur, as in the case of the surfacing material, after a definite amount of work has been done on the rock. An often-repeated light blow produces no appreciable effect on the cube, and it is only when the violence of the blow is increased so as to stress the material beyond its elastic limit that rupture occurs. This point has an important bearing in practice, and explains why roads, such as park roads, subjected to continuous light traffic, wear very slowly, whereas others similarly built and subjected to occasionally heavy traffic rapidly go to pieces.

During the past winter a few determinations were made of the effect of frost upon the volume of compressed stone dust such as is used for the surfacing of roads. Briquettes of the dust were saturated with water, and, after a long exposure considerably below the freezing point, were found, on the average, to have increased in volume by about five-tenths of one per cent. The maximum increase in volume did not exceed one per cent.

Besides the above work, a complete map has been made of the town of Winchester, showing the occurrence of all rock ledges, and giving estimates of all the available road-building stone.

Table showing Specific Densities, Coefficients of Abrasion and Cementing Values of Stones tested.

LOCALITY FROM WHICH STONE COMES.		Specific Density	Coefficient of Abrasion	Name of Stone.	Number of Specimens	Cementing Value
Specimen No.	Date					
*37, IV. (22-N), Ipswich, Essex Co., Mass.,	·	·	2.94	24.05	Diabase,	·
Ware, Worcester Co., Mass.,	·	3.00	23.31	Diabase,	·	6.9
N. E. Trap Rock Co., West Springfield, Hampden Co.,	·	·	·	·	·	7.3
Mass.,	·	·	·	·	·	·
W.N. Flynt Granite Co., Monson, Hampden Co., Mass.,	·	2.96	22.14	Diabase,	·	77
31, VII. (16-Y), Saugus, Essex Co., Mass.,	·	3.01	22.13	Diabase,	·	78
31, II. (32-L), Newton, Middlesex Co., Mass.,	·	3.03	21.22	Diabase,	·	40
36, VI. (32-G), Newbury, Essex Co., Mass.,	·	2.80	20.79	Trachyte,	·	19
38, I. (16-D), Lynn, Essex Co., Mass.,	·	2.95	20.40	Diabase,	·	39
38, I. (12-C), Lynn, Essex Co., Mass.,	·	3.03	20.37	Diabase,	·	28
*31, VII. (20-V), Holyoke, Hampden Co., Mass.,	·	3.03	19.77	Diabase,	·	27
38, I. (10-C), Lynn, Essex Co., Mass.,	·	2.93	19.67	Diabase,	·	75
38, I. (10-C), Lynn, Essex Co., Mass.,	·	3.03	18.25	Diabase,	·	35
*36, VI. (7-P), Lawrence, Essex Co., Mass.,	·	2.99	18.17	Diabase,	·	36
36, VI. (3-H), Newburyport, Essex Co., Mass.,	·	2.75	17.20	Limestone,	·	74
31, VII. (21-Y), Saugus, Essex Co., Mass.,	·	2.80	16.76	Camptonite,	·	43
31, VII. (25-P), Boston, Suffolk Co., Mass.,	·	2.72	16.10	Diabase,	·	47
31, VII. (24-W), Saugus, Essex Co., Mass.,	·	3.01	16.08	Diabase,	·	29
31, IV. (31-N), Medford, Middlesex Co., Mass.,	·	2.66	16.06	Felsite, ·	·	52
12, II. (25-R), West Springfield, Hampden Co., Mass.,	·	3.01	16.02	Diabase,	·	32
37, VI. (31-F), Salem, Essex Co., Mass.,	·	3.03	15.82	Diabase,	·	26
	·	2.96	15.60	Olivene diabase,	·	16
	·	2.92	15.55	Augite diorite,	·	82
	·	·	·	·	·	27

*	38,	III.	(30-K), Quincy, Norfolk Co., Mass.,	·	·	·	·	2.83	15.49	Diabase,	·	·	·	·	·	81
*			Haverstraw, N. Y.,	·	·	·	·	2.96	15.21	Diabase,	·	·	·	·	·	24
31,	VI.	(7-B), Brookline, Norfolk Co., Mass.,	·	·	·	·	2.92	14.91	Diabase,	·	·	·	·	·	61	
38,	I.	(12-K), Lynn, Essex Co., Mass.,	·	·	·	·	2.99	14.71	Olivene diabase,	·	·	·	·	·	30	
*			Rockport, Knox Co., Me.,	·	·	·	·	2.66	14.66	Felsite, ·	·	·	·	·	·	31
*			Montserrat Crushing Plant, ·	·	·	·	·	2.67	14.60	Quartzite, ·	·	·	·	·	·	67
36,	VI.	(29-I), Newbury, Essex Co., Mass.,	·	·	·	·	2.75	14.58	Hornblende granite,	·	·	·	·	·	71	
31,	VIII.	(6-N), Everett, Middlesex Co., Mass.,	·	·	·	·	2.94	14.45	Quartz diorite,	·	·	·	·	·	45	
44,	III.	(26-L), Duxbury, Plymouth Co., Mass.,	·	·	·	·	2.87	13.87	Olivene diabase (coarse grained),	·	·	·	·	·	14	
*			East Providence, R. I., ·	·	·	·	·	2.68	13.46	Hornblende granite,	·	·	·	·	·	4
31,	VII.	(26-T), Revere, Suffolk Co., Mass.,	·	·	·	·	2.72	13.42	Grit (carboniferous?),	·	·	·	·	·	60	
43,	II.	(32-F), Gloucester, Essex Co., Mass.,	·	·	·	·	2.65	13.21	Felsite, ·	·	·	·	·	·	15	
*			Uxbridge, Worcester Co., Mass.,	·	·	·	·	2.75	12.63	Angite nepheline syenite,	·	·	·	·	·	37
43,	IV.	(34-K), Rockport, Essex Co., Mass.,	·	·	·	·	2.70	12.62	Hornblende granite,	·	·	·	·	·	72	
38,	I.	(12-N), Lynn, Essex Co., Mass.,	·	·	·	·	2.63	12.57	Hornblende granite,	·	·	·	·	·	44	
26,	VIII.	(23-V), Waltham, Middlesex Co., Mass.,	·	·	·	·	2.83	12.50	Diabase (poor specimen),	·	·	·	·	·	17	
*			Lee, Berkshire Co., Mass.,	·	·	·	·	2.66	12.30	Felsite, ·	·	·	·	·	·	6
31,	VI.	(3-B), Brookline, Norfolk Co., Mass.,	·	·	·	·	2.82	12.21	Schist, ·	·	·	·	·	·	11	
43,	II.	(2-U), Gloucester, Essex Co., Mass.,	·	·	·	·	2.62	12.16	Hornblende granitite,	·	·	·	·	·	16	
*			Buckland, Franklin Co., Mass.,	·	·	·	·	2.73	12.15	Schist, ·	·	·	·	·	·	5
31,	VI.	(16-K), Lee, Berkshire Co., Mass.,	·	·	·	·	2.73	11.71	Schist, ·	·	·	·	·	·	53	
43,	II.	(3-B), Brookline, Norfolk Co., Mass.,	·	·	·	·	2.60	11.65	Quartzite, ·	·	·	·	·	·	64	
*			Walpole, Norfolk Co., Mass.,	·	·	·	·	2.60	11.57	Conglomerate, ·	·	·	·	·	·	9
5,	III.	(16-K), Lee, Berkshire Co., Mass.,	·	·	·	·	2.92	11.43	Gneiss, ·	·	·	·	·	·	80	
31,	VI.	(3-B), Brookline, Norfolk Co., Mass.,	·	·	·	·	2.87	11.40	Hornblende diorite,	·	·	·	·	·	23	
43,	II.	(2-U), Gloucester, Essex Co., Mass.,	·	·	·	·	2.64	11.03	Hornblende granite,	·	·	·	·	·	33	
*			Northampton, Hampshire Co., Mass.,	·	·	·	·	2.74	10.69	Hornblende granite,	·	·	·	·	·	6
32,	VII.	(3-P), Chester, Hampden Co., Mass.,	·	·	·	·	3.74	10.62	Magnetite corundum gneiss,	·	·	·	·	·	10	
*			Quincy, Norfolk Co., Mass.,	·	·	·	·	2.66	10.16	Hornblende granite, ·	·	·	·	·	·	35
*				·	·	·	·	·	·	·	·	·	·	·	22	
*				·	·	·	·	·	·	·	·	·	·	·	-	

* Tests made this year.

Table showing Specific Densities, etc.—Concluded.

LOCALITY FROM WHICH STONE COMES.		Name of Stone.		Cementitious Value.		Number of Specimens.	
		Specific Den.	Weight of specimen.	Specific Den.	Weight of specimen.		
*	13, IX.	(1-R) Plymouth, Plymouth Co., Mass., Providence, R. I., Co., Mass., Orange, Franklin Co., Mass., E. H. Humprey, Pittsfield, Berkshire Co., Mass.,	2.66 2.69 2.77 2.70	10.10 10.02 9.78 9.57	Field stone (erratics), Grit (carboniferous?), Hornblende granite, Mica schist,	42 46 51 79	11 — 12 —
*	3, IV.	(23-T) Providence, R. I., Great Barrington, Berkshire Co., Mass., Nantucket, Nantucket Co., Mass.,	2.86	9.52	Grit (carboniferous?), Limestone,	55 59	— —
*	2, VII.	(28-D) Iron Mountain, Cumberland, R. I., Pittsfield, Berkshire Co., Mass.,	3.61 2.82	9.42 9.38	Field stone (erratics), Peridotite, Limestone,	23 49	— —
31, V.	(14-T)	Somerville, Middlesex Co., Mass., North Attleborough, Bristol Co., Mass., Diamond Hill, Cumberland, R. I., Rockport, Knox Co., Me.,	2.86	9.28	Baseball (very coarse grained), Field stone (erratics),	25 11	34 —
*	31, VII.	(12-W) Sangus, Essex Co., Mass., Tisbury, County of Dukes Co., Mass., Mattapoisett, Plymouth Co., Mass., Newton Middlesex Co., Mass.,	2.62	9.07	Quartzite,	54	9
*	31, V.	(1-Y) (7-M) Somerville, Middlesex Co., Mass., Ashby, Middlesex Co., Mass., Gordon Co., Ga.,	2.74 2.70	9.00 8.99	Limestone, Hornblende granite, Field stone (erratics),	66 38 41	— — 9
*	2, VIII.	(24-R) Rockport, Knox Co., Me., Lenox, Berkshire Co., Mass., Franklin Co., Mass., (26-B), Buckland, Franklin Co., Mass.,	2.84 2.96	8.04 7.94	Conglomerate, Slate (Cambrian?), Granite, Chert, Limestone, Schist, Hornblende gneiss,	20 8 68 50 65 2 62	14 — — — — 27 8

Tomkin's Cove, N. Y.	2.84	7.84	Limestone (siliceous),	57
Holden, Worcester Co., Mass.,	—	6.68	Field stone (erratics),	18
Tomkin's Cove, N. Y.	2.78	6.31	Limestone (siliceous),	7
Whitman, Plymouth Co., Mass.,	—	5.93	Field stone (erratics),	12
Paxton, Worcester Co., Mass.,	—	2.83	Granitoid gneiss,	48
2, IX. (15-Z), Lee, Berkshire Co., Mass.,	2.74	2.85	Marble, .	1

• Tests made this year.

The first arabic numeral preceding the name of the locality indicates the sheet of the United States geological survey map of Massachusetts; the roman numeral, one of the nine sections into which the map is divided; the number and letter in parentheses, the exact location whence the specimen came. In this last method of indicating, each section of the map is divided vertically into twenty-six divisions, designated by the letters of the alphabet, and horizontally into thirty-four divisions, which are indicated by numbers.

It seems well to retain these note-book indications for the reason that they afford a tolerably accurate and quite permanent record as to the site of the specimens that have been tested.

LOGAN WALLER PAGE,
Geologist.

APPENDIX H.

SHOWING THE ACTS AND RESOLVES UNDER WHICH
THE WORK OF THE COMMISSION IS CARRIED
ON.

[ACTS OF 1893, CHAPTER 476.]

AN ACT TO PROVIDE FOR THE APPOINTMENT OF A HIGHWAY COM-
MISSION TO IMPROVE THE PUBLIC ROADS AND TO DEFINE ITS
POWERS AND DUTIES.*Be it enacted, etc., as follows:*

SECTION 1. The governor, with the advice and consent of the council, shall, within thirty days after the passage of this act, appoint three competent persons, to serve as the Massachusetts Highway Commission. Their terms of office shall be so arranged and designated at the time of their appointment that the term of one member shall expire in three years, one in two years and one in one year. The full term of office thereafter shall be for three years, and all vacancies occurring shall be filled by the governor, with the advice and consent of the council. The members of said board may be removed by the governor, with the advice and consent of the council, for such cause as he shall deem sufficient and shall express in the order of removal. They shall each receive in full compensation for their services an annual salary of two thousand dollars, payable in equal monthly instalments, and also their travelling expenses. They may expend annually for clerk hire, engineers and for defraying expenses incidental to and necessary for the performance of their duties, exclusive of office rent, the sum of two thousand dollars. They shall be provided with an office in the state house or some other suitable place in the city of Boston, in which the records of their office shall be kept. They may establish rules and regulations for the conduct of business and for carrying out the provisions of this act.

SECT. 2. They shall from time to time compile statistics relating to the public roads of cities, towns and counties, and make such investigations relating thereto as they shall deem expedient. They may be consulted at all reasonable times, without charge, by officers of counties, cities or towns having the care of and authority over public roads, and shall without charge advise them relative

to the construction, repair, alteration or maintenance of the same ; but advice given to them by any such officers shall not impair the legal duties and obligations of any county, city or town. They shall prepare a map or maps of the Commonwealth on which shall be shown county, city and town boundaries and also the public roads, particularly the state highways, giving, when practicable, the names of the same. They shall collect and collate information concerning the geological formation of this Commonwealth, so far as it relates to the material suitable and proper for road building, and shall, so far as practicable, designate on said map or maps the location of such material. Such map or maps shall at all reasonable times be open for the inspection of officers of counties, cities and towns having the care of and authority over public roads. They shall each year hold at least one public meeting in each county for the open discussion of questions relating to the public roads, due notice of which shall be given in the press or otherwise.

SECT. 3. They shall make an annual report to the legislature of their doings and the expenditures of their office, together with such statements, facts and explanations bearing upon the construction and maintenance of public roads, and such suggestions and recommendations as to the general policy of the Commonwealth in respect to the same as may seem to them appropriate. Their report shall be transmitted to the secretary of the Commonwealth on or before the first Wednesday in January of each year, to be laid before the legislature. All maps, plans and statistics collected and compiled under their direction shall be preserved in their office.

SECT. 4. County commissioners and city and town officers having the care of and authority over public roads and bridges throughout the Commonwealth shall, on request, furnish the commissioners any information required by them concerning the roads and bridges within their jurisdiction.

SECT. 5. For the purpose of carrying out the provisions of this act said commission may expend such sums for necessary assistants, the procuring of necessary supplies, instruments, material, machinery and other property, and for the construction and maintenance of state highways, as shall from time to time be appropriated by the legislature ; and they shall in their annual report state what sums they deem necessary for the year commencing with the first day of March following.

SECT. 6. [Repealed.] Whenever the county commissioners of a county adjudge that the common necessity and convenience require that the Commonwealth acquire as a state highway a new or an existing road in that county, they may apply by petition in

writing to the Massachusetts highway commission, stating the road they recommend, and setting forth a detailed description of said road by metes and bounds, together with a plan and profile of the same. Said commission shall consider such petition, and if they adjudge that it ought to be allowed, they shall in writing so notify said county commissioners. It shall then become the duty of said county commissioners to cause said road to be surveyed and laid out in the manner provided for the laying out and alteration of highways, the entire expense thereof to be borne and paid by said county. Said county commissioners shall preserve a copy of such petition, plans and profiles with their records for public inspection. When said commission shall be satisfied that said county commissioners have properly surveyed and laid out said road, and set in place suitable monuments, and have furnished said commission with plans and profiles, on which shall be shown such monuments and established grades, in accordance with the rules and regulations of said commission, said commission may approve the same, and so notify in writing said county commissioners. Said commission shall then present a certified copy of said petition on which their approval shall be indicated, together with their estimates for constructing said road and the estimated annual cost for maintaining the same, to the secretary of the Commonwealth, who shall at once lay the same before the legislature, if it is in session, otherwise on the second Wednesday of January following. If the legislature makes appropriation for constructing said road, said commission shall cause said road to be constructed in accordance with this act, and when completed and approved by them said road shall become a state highway, and thereafter be maintained by the Commonwealth under the supervision of said commission.

SECT. 7. [*Repealed.*] Two or more cities or towns may petition the said commission representing that, in their opinion, the common necessity and convenience require that the Commonwealth should acquire as a state highway a new or an existing road leading from one city or town to another, which petition shall be accompanied by a detailed description of such road by metes and bounds, and also a plan and profile of the same. If said commission adjudge that the common necessity and convenience require such road to be laid out and acquired as a state highway, they shall cause a copy of said petition, on which shall be their finding, to be given to the county commissioners of the county in which said road or any portion of it lies. It shall then become the duty of the county commissioners, at the expense of the county, to cause said road to be surveyed and laid out, and to set in place suitable monuments and to cause a detailed description by metes

and bounds, plans and profiles to be made, on which shall be shown said monuments and established grades, and to give the same to said commission; but said county commissioners shall have the right to change the line of said road, provided the termini are substantially the same. Said county commissioners shall preserve said petition and a copy of the plans and profiles, with their records, for public inspection. When said commission shall be satisfied that the county commissioners have properly surveyed and laid out said road and set in place suitable monuments, and have furnished them with plans and profiles on which shall be shown said monuments and established grades, in accordance with the rules and regulations of said commission, they shall then proceed in the same manner as provided in section six of this act; and when said road is completed, and approved by said commission, it shall become a state highway, and thereafter be maintained by the Commonwealth under the supervision of said commission.

SECT. 8. [*Repealed.*] In all cases where a highway is to be constructed at the expense of the Commonwealth as a state highway, all the grading necessary to make said highway of the established grade, and the construction of culverts and bridges, shall be paid for by the county or counties, respectively, in which said highway or any portion of it lies, and the work must be done to the satisfaction of said commission. No action by a person claiming damage for the taking of land or change of grade, under the provisions of this act, shall be commenced against a county until said commission has taken possession for the purpose of constructing such state highway.

SECT. 9. [*Repealed.*] When appropriation has been made by the legislature for the construction of a state highway, said commission shall at once cause plans and specifications to be made and estimate the cost of the construction of such state highway, and give to each city and town in which said road lies, a certified copy of said plans and specifications, with a notice that said commission is ready for the construction of said road. Such city or town shall have the right, without advertisement, to contract with said commission for the construction of so much of such highway as lies within its limits, in accordance with the plans and specifications of the commission and under its supervision and subject to its approval, at a price agreed upon between said commission and said city or town; but such price agreed upon shall not exceed eighty-five per cent. of the original estimate of said commission. If such city or town shall within thirty days not elect to so contract, said commission may advertise in one or more papers published in the county where the road or portion of it is situated,

and in one or more papers published in Boston, for bids for the construction of said highway in accordance with the plans and specifications furnished by said commission, and under their supervision and subject to their approval. Said commission shall have the right to reject any and all bids, and they shall require of the contractor a bond for at least ten thousand dollars for each mile of road, to indemnify such city or town in which such highway lies against damage while such road is being constructed, and the Commonwealth shall not be liable for any damage occasioned thereby. Said commission shall make and sign all contracts in the name of the Massachusetts highway commission.

SECT. 10. For the maintenance of state highways, said commission shall contract with the city or town in which such state highway lies, or a person, firm or corporation, for the keeping in repair and maintaining of such highway, in accordance with the rules and regulations of said commission, and subject to their supervision and approval, and such contracts may be made without previous advertisement.

SECT. 11. [*Repealed.*] All contracts made by or with the Massachusetts highway commission under the provisions of this act shall be subject to the approval of the governor and council.

SECT. 12. No length of possession, or occupancy of land within the limit of any state highway, by an owner or occupier of adjoining land, shall create a right to such land in any adjoining owner or occupant or a person claiming under him, and any fences, buildings, sheds or other obstructions encroaching upon such state highway shall, upon written notice by said commission, at once be removed by the owner or occupier of adjoining land, and if not so removed said commission may cause the same to be done and may remove the same upon the adjoining land of such owner or occupier.

SECT. 13. [*Repealed.*] The Commonwealth shall be liable for injuries to persons or property occurring through a defect, or want of repair or of sufficient railing, in or upon a state highway.

SECT. 14. Cities and towns shall have police jurisdiction over all state highways, and they shall at once notify in writing the state commission or its employees of any defect or want of repair in such highways. No state highway shall be dug up for laying or placing pipes, sewers, posts, wires, railways or other purposes, and no tree shall be planted or removed or obstruction placed thereon, except by the written consent of the superintendent of streets or road commissioners of a city or town, approved by the highway commission, and then only in accordance with the rules and regulations of said commission; and in all cases the work shall be executed under the supervision and to the satisfaction of said com-

mission, and the entire expense of replacing the highway in as good condition as before shall be paid by the parties to whom the consent was given or by whom the work was done; but a city or town shall have the right to dig up such state highway without such approval of the highway commission where immediate necessity demands it, but in all such cases such highways shall be at once replaced in as good condition as before, and at the expense of the city or town. Said commission shall give suitable names to the state highways, and they shall have the right to change the name of any road that shall have become a part of a state highway. They shall cause to be erected, at convenient points along state highways, suitable guide posts.

SECT. 15. The word "road," as used in this act, includes every thoroughfare which the public has a right to use.

SECT. 16. This act shall take effect upon its passage. [Approved June 10, 1893.

[ACTS OF 1894, CHAPTER 497.]

AN ACT RELATING TO STATE HIGHWAYS.

Be it enacted, etc., as follows:

SECTION 1. Whenever the county commissioners of a county, or the mayor and aldermen of a city, or the selectmen of a town, adjudge that the public necessity and convenience require that the Commonwealth take charge of a new or an existing road as a highway, in whole or in part, in that county, city or town, they may apply by a petition in writing to the Massachusetts highway commission, stating the road they recommend, together with a plan and profile of the same.

SECT. 2. Said highway commission shall consider such petition and determine what the public necessity and convenience require in the premises, and, if they deem that the highway should be laid out or be taken charge of by the Commonwealth, shall file a plan thereof in the office of the county commissioners of the county in which the petitioners reside, with the petition therefor and a certificate that they have laid out and taken charge of said highway in accordance with said plan, and shall file a copy of the plan and location of the portion lying in each city or town in the office of the clerk of said city or town, and said highway shall, after the filing of said plans, be laid out as a highway, and shall be constructed and kept in good repair and condition as a highway by the said commission, at the expense of the Commonwealth, and shall be known as a state road, and thereafter be maintained by the Com-

monwealth under the supervision of said commission. And all openings and placing of structures in any such road shall be done in accordance with a permit from said commission.

SECT. 3. The damages sustained by any person whose property is taken for, or is injured by the construction of any such highway shall be paid by the Commonwealth, the same to be determined by said commission. And if said commission and the person sustaining the damages cannot agree thereon he or they may have said damages determined by a jury in the county in which the land is situated, by filing a petition for such jury in the office of the clerk of the superior court for said county at any time before the expiration of one year from the completion of said highway, and thereupon said damages shall be determined by a jury at the bar of said court in the same manner as damages for the taking of land for other highways in the county, city or town are determined; and costs shall be taxed to the prevailing party on such petition, as in civil cases.

SECT. 4. Said commission shall, when about to construct any highway, give to each city and town in which said highway lies a certified copy of the plans and specifications for said highway, with a notice that said commission is ready for the construction of said road. Such city or town shall have the right, without advertisement, to contract with said commission for the construction of so much of such highway as lies within its limits, in accordance with the plans and specifications, and under its supervision and subject to its approval, at a price agreed upon between said commission and said city or town. If said city or town shall not elect to so contract within thirty days said commission shall advertise in two or more papers published in the county where the road or a portion of it is situated, and in three or more daily papers published in Boston, for bids for the construction of said highway under their supervision and subject to their approval, in accordance with plans and specifications to be furnished by said commission. Such advertisements shall state the time and place for opening the proposals in answer to said advertisements, and reserve the right to reject any and all proposals. All such proposals shall be sealed and shall be kept by the board, and shall be open to public inspection after said proposals have been accepted or rejected. Said commission may reject any or all bids, or if a bid is satisfactory they shall, with the approval of the governor and council, make a contract in writing on behalf of the Commonwealth for said construction, and shall require of the contractor a bond for at least twenty-five per cent. of the contract price to indemnify any city or town in which such highway lies against

damage while such road is being constructed ; and the Commonwealth shall not be liable for any damage occasioned thereby. All construction of state roads shall be fairly apportioned by said commission among the different counties, and not more than ten miles of state road shall be constructed in any one county in any one year on petition as aforesaid, without the previous approval thereof in writing by the governor and council.

SECT. 5. One quarter of any money expended under the provisions of this act in any county for a highway, with interest on said quarter at the rate of three per cent. per annum, shall be repaid by said county to the Commonwealth, in such reasonable sums and at such times within six years thereafter as said commission, with the approval of the state auditor, shall determine, taking into consideration the financial condition of the county ; and the treasurer and receiver-general shall apply all money so repaid to the appropriation to be expended by said commission. The county treasurer, with the approval of the county commissioners may make such loans as they may see fit to meet this expenditure.

SECT. 6. Any city or town in which a state highway is situated shall be liable for injuries to persons travelling upon a state highway the same as upon other highways, but the amount actually recovered as damages for such injuries shall be repaid within one year thereafter to such city or town by the Commonwealth. A city or town may make temporary necessary repairs of a state highway without the approval of said commission.

SECT. 7. Said commission shall keep all state roads reasonably clear of brush, and shall cause suitable shade trees to be set out along said highways when feasible, and shall renew the same when necessary, and may also establish and maintain watering troughs at suitable places along said highways.

SECT. 8. For the purpose of meeting any expenses that may be incurred under the provisions of chapter four hundred and seventy-six of the acts of the year eighteen hundred and ninety-three, as hereby amended, including the salaries and expenses of the commission, the treasurer and receiver-general is hereby authorized, with the approval of the governor and council, to issue scrip or certificates of indebtedness to an amount not exceeding three hundred thousand dollars, for a term not exceeding thirty years. Said scrip or certificates of indebtedness shall be issued as registered bonds or with interest coupons attached, and shall bear interest not exceeding four per centum per annum, payable semi-annually on the first days of April and October in each year. Such scrip or certificates of indebtedness shall be designated on

the face as the State Highway Loan, shall be countersigned by the governor, and shall be deemed a pledge of the faith and credit of the Commonwealth, and the principal and interest shall be paid at the times specified therein in gold coin of the United States or its equivalent; and said scrip or certificates of indebtedness shall be sold and disposed of at public auction or in such other mode and at such times and prices and in such amounts and at such rates of interest, not exceeding the rate above specified, as shall be deemed best. The treasurer and receiver-general shall, on issuing any of said scrip or certificates of indebtedness, establish a sinking fund for the payment of said bonds, into which shall be paid any premiums received on the sale of said bonds, and he shall apportion thereto from year to year, in addition, amounts sufficient with the accumulations to extinguish at maturity the debt incurred by the issue of said bonds. The amount necessary to meet the annual sinking fund requirements and to pay the interest on said bonds shall be raised by taxation from year to year.

SECT. 9. Sections six, seven, eight, nine, eleven and thirteen of chapter four hundred and seventy-six of the acts of the year eighteen hundred and ninety-three are hereby repealed.

SECT. 10. This act shall take effect upon its passage. [Approved June 20, 1894.]

[ACTS OF 1895, CHAPTER 347.]

AN ACT RELATIVE TO THE CONSTRUCTION OF STATE HIGHWAYS.

Be it enacted, etc., as follows:

SECTION 1. The Massachusetts highway commission is hereby authorized to expend a sum not exceeding four hundred thousand dollars for the construction of state highways during the current year, in accordance with the provisions of chapter four hundred and seventy-six of the acts of the year eighteen hundred and ninety-three and chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four.

SECT. 2. No persons except citizens of this Commonwealth shall be employed on the work authorized by this act.

SECT. 3. For the purpose of meeting any expenses which may be incurred under the provisions of this act the treasurer and receiver-general is hereby authorized, with the approval of the governor and council, to issue scrip or certificates of indebtedness to an amount not exceeding four hundred thousand dollars, for a term not exceeding thirty years. Said scrip or certificates of indebtedness shall be issued as registered bonds or with interest coupons

attached, and shall bear interest not exceeding four per cent. per annum, payable semi-annually on the first days of April and October in each year. Such scrip or certificates of indebtedness shall be designated on their face as the State Highway Loan, shall be countersigned by the governor, and shall be deemed the pledge of the faith and credit of the Commonwealth; and the principal and interest thereof shall be paid at the times specified therein in gold coin of the United States or its equivalent; and said scrip or certificates of indebtedness shall be sold and disposed of at public auction, or in such other manner, at such times and prices, in such amounts and at such rates of interest not exceeding the rate above specified, as shall be deemed best. The sinking fund established by chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four shall also be maintained for the purpose of extinguishing bonds issued under the authority of this act, and the treasurer and receiver-general shall apportion thereto from year to year an amount sufficient with the accumulations of said fund to extinguish at maturity the debt incurred by the issue of said bonds. The amount necessary to meet the annual sinking fund requirements and to pay the interest on said bonds shall be raised by taxation from year to year.

SECT. 4. This act shall take effect upon its passage. [Approved May 1, 1895.]

[RESOLVES OF 1896, CHAPTER 86.]

RESOLVE RELATIVE TO A STATE HIGHWAY BETWEEN THE CITY OF BOSTON AND THE CITY OF NEWBURYPORT.

Resolved, That the Massachusetts Highway Commission consider the expediency of laying out a state highway between the city of Boston and the city of Salem or the city of Newburyport, over the shore route, so-called; which route may be described substantially as follows: —

Starting from the south ferry, at Lewis street, in Boston, thence through Lewis street to Maverick square, thence through Maverick square to Chelsea street, thence over Chelsea street to Bennington street, thence over Bennington street to Orient Heights, thence over the main traveled road to the town of Revere, continuing on the main road to Beachmont, continuing over the main traveled road, known as Ocean avenue, along the ocean front to the Point of Pines, crossing the Saugus river on the easterly side of the Boston, Revere Beach and Lynn railroad and running to the south end of Sea street in Lynn, thence through Sea street to Broad

street, thence through Broad street to Lewis street, thence through Lewis street to New Ocean street, thence through New Ocean street to the town of Swampscott, thence through New Ocean street, in Swampscott, to the junction of Burrill street and Paradise road, thence over Paradise road to the northeast end of said road, thence through Paradise woods on nearly a straight line to Vining square, at the junction of the towns of Swampscott and Marblehead and the city of Salem, thence northerly to Loring avenue in the city of Salem, thence over Loring avenue to Lafayette street, thence over Lafayette street to Central street, thence over Central street to Essex street, thence through Salem to and over Beverly bridge, thence through the city of Beverly, and thence to Newburyport, using the present traveled roads as far as may be, with such additions of new road as may be necessary. Said Massachusetts Highway Commission shall report to the next general court the probable cost of such a highway, with such other information as may be obtained in relation thereto, on or before the thirty-first day of January in the year eighteen hundred and ninety-seven. *[Approved April 28, 1896.]*

[ACTS OF 1896, CHAPTER 345.]

AN ACT RELATIVE TO STATE HIGHWAYS.

Be it enacted, etc., as follows:

SECTION 1. When a highway is laid out as a state road the Massachusetts highway commission shall construct and maintain that portion of the way between the inside lines of sidewalks upon either side. The sidewalks of said road may be constructed and maintained in accordance with the Public Statutes and amendments thereto, and the provisions of section six of chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four shall only apply to that portion of the way between the inside lines of sidewalks. The inside lines of sidewalks referred to in this section are those lines which are nearest to the centre of the highway.

SECT. 2. A city or town in which a state road lies shall at its own expense keep such road sufficiently clear of snow and ice so that the same shall be reasonably safe for travel, as now required by the Public Statutes and amendments thereto.

SECT. 3. Instead of filing the original petition with the county commissioners, as now required by section two of chapter four hundred and ninety-seven of the acts of the year eighteen hundred and

ninety-four, it shall hereafter be sufficient to file a certified copy thereof with said county commissioners.

SECT. 4. This act shall take effect upon its passage. [Approved April 28, 1896.]

[ACTS OF 1896, CHAPTER 481.]

AN ACT RELATIVE TO THE CONSTRUCTION OF STATE HIGHWAYS.

Be it enacted, etc., as follows:

SECTION 1. The Massachusetts highway commission is hereby authorized to expend a sum not exceeding six hundred thousand dollars for the construction of state highways, in accordance with the provisions of chapter four hundred and seventy-six of the acts of the year eighteen hundred and ninety-three and chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four.

SECT. 2. No persons except citizens of this Commonwealth shall be employed on the work authorized by this act.

SECT. 3. For the purpose of meeting any expenses which may be incurred under the provisions of this act the treasurer and receiver general is hereby authorized, with the approval of the governor and council, to issue scrip or certificates of indebtedness to an amount not exceeding six hundred thousand dollars, for a term not exceeding thirty years. Said scrip or certificates of indebtedness shall be issued as registered bonds or with interest coupons attached, and shall bear interest not exceeding four per cent. per annum, payable semi-annually on the first day of April and of October in each year. Such scrip or certificates of indebtedness shall be designated on their face as the State Highway Loan, shall be countersigned by the governor, and shall be deemed a pledge of the faith and credit of the Commonwealth; and the principal and interest thereof shall be paid at the times specified therein in gold coin of the United States or its equivalent, and said scrip or certificates of indebtedness shall be sold and disposed of at public auction, or in such other manner, at such times and prices, in such amounts and at such rates of interest, not exceeding the rate above-specified, as shall be deemed best. The sinking fund established by chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four shall also be maintained for the purpose of extinguishing bonds issued under the authority of this act, and the treasurer and receiver general shall apportion thereto from year to year an amount sufficient with the accumulations of said fund to extinguish at maturity the debt incurred by the issue

of said bonds. The amount necessary to meet the annual sinking fund requirements and to pay the interest on said bonds shall be raised by taxation from year to year.

SECT. 4. This act shall take effect upon its passage. [Approved June 4, 1896.]

[ACTS OF 1896, CHAPTER 513.]

AN ACT TO PROVIDE FOR AIDING TOWNS IN THE CONSTRUCTION AND MAINTENANCE OF BETTER ROADS.

Be it enacted, etc., as follows:

SECTION 1. Upon the application to the Massachusetts highway commission of the county commissioners of any county, made at the request of any town of not more than twelve thousand inhabitants within said county, there shall be furnished by said highway commission to said county, at the expense of the Commonwealth, one or more steam rollers, portable stone crushers and such other road machines as the said highway commission may deem necessary for the construction and maintenance of better roads in the town making such request. Such machines shall remain the property of the Commonwealth and shall be managed and maintained under the direction of the county commissioners. The county commissioners shall engage competent engineers and skilled mechanics to operate said machines, who shall be paid from the county treasury such sums for each day's actual services as the county commissioners may determine. The expenses so incurred shall be repaid to the county by the towns using said machines, as apportioned by the county commissioners, in proportion to the time in which such machines were used by them.

SECT. 2. Chapter four hundred and eighty-six of the acts of the year eighteen hundred and ninety-five is hereby repealed.

SECT. 3. This act shall take effect upon its passage. [Approved June 6, 1896.]

[ACTS OF 1896, CHAPTER 548.]

AN ACT MAKING APPROPRIATIONS FOR EXPENSES AUTHORIZED BY THE PRESENT LEGISLATURE AND FOR CERTAIN OTHER EXPENSES AUTHORIZED BY LAW.

Be it enacted, etc., as follows:

• • • • •

For expenses in connection with aiding towns in the construction and maintenance of better roads, as authorized by chapter

five hundred and thirteen of the acts of the present year, a sum not exceeding twelve thousand dollars.

SECT. 2. This act shall take effect upon its passage. [Approved June 9, 1896.]

[ACTS OF 1896, CHAPTER 541.]

AN ACT RELATIVE TO STREET RAILWAYS LOCATED ON STATE HIGHWAYS.

Be it enacted, etc., as follows:

SECTION 1. Whenever in the construction of a state highway it becomes necessary, in the opinion of the Massachusetts highway commission, to change the location, relay or change the grade of that part of any street railway located on said highway, or to place different material between its tracks, or to make any other change in the location and construction of said railway, said commission may, in the manner provided in section twenty-two of chapter one hundred and thirteen of the Public Statutes for making such changes by boards of aldermen and selectmen, order the company owning or operating said railway to make such changes: *provided, however,* that the company shall thereafter enjoy the same rights in the new location that it had in the original location; and unless the same are made within the time limited by said commission the commission may make said changes, and the cost of making the same, whether by the railway company or by said commission, shall be paid by said commission; said cost with interest at a rate not exceeding four per cent. per annum, shall be paid by said railway company to the Commonwealth in ten equal annual payments; and the auditor of the Commonwealth on or before the first day of July in each year shall certify the amount due to the tax commissioner, who shall forthwith demand the same; and payment shall be made within thirty days thereafter. The claim of the Commonwealth shall have priority over all other claims against said railway company, except for labor, and shall be collected in the same manner as the corporation tax; but any such company may itself pay for the expenses of said changes at the time of making the same, and may anticipate said annual payments in whole or in part.

SECT. 2. This act shall take effect upon its passage. [Approved June 9, 1896.]

APPENDIX I.

SHOWING THE METHOD OF PROCEDURE IN PETITIONING FOR STATE HIGHWAYS.

Section 1, chapter 497 of the Acts of 1894, reads as follows: " Whenever the county commissioners of a county, or the mayor and aldermen of a city, or the selectmen of a town, adjudge that the public necessity and convenience require that the Commonwealth take charge of a new or an existing road as a highway, in whole or in part, in that county, city or town, they may apply by a petition in writing to the Massachusetts highway commission, stating the road they recommend, together with a plan and profile of the same."

Before any action toward laying out and constructing a State highway can be taken by the commission, it is necessary that a petition, signed either by the selectmen of a town, the mayor and aldermen of a city or the county commissioners of a county in which the road lies, accompanied by a plan and profile prepared in accordance with the requirements of the commission, be filed in the highway commissioners' office.

The requirements of the commission in relation to the survey and plans of the roads petitioned for are as follows: —

The plans shall be made on the scale of forty feet to the inch, showing all land lines, owners' names, location of and width between present lines, present fences, walls, bridges and guard rails, location and width of travelled way, and all houses within one hundred feet of the street lines; also a profile, forty feet to the inch horizontal scale and eight feet vertical, stations one hundred feet apart, and cross-sections at every station (the stations as shown on the plan to correspond with the stations shown on profile and cross-sections; *i. e.*, the profile is to indicate the grades on the base line of the survey, and the zero point of cross-sections is to be made on the base line).

The plan, with profile on the same sheet, should be in sections of not more than one mile each, and may be drawn on either brown detail paper or tracing cloth of good quality, the detail paper being preferred.

The cross-sections should be plotted on sheets about three by four feet, and should show the full width of the present location and indicate the side slopes, if any, at least two inches being left between each section as drawn on sheet.

The plans are most convenient if made in sections, each showing a length of one mile.

Following are shown the forms of petitions for State highways, which have been prepared by the Massachusetts Highway Commission, and which may be obtained upon application: —

COMMONWEALTH OF MASSACHUSETTS.

To the Massachusetts Highway Commission.

Respectfully represent your petitioners that they are the county commissioners of the county of ; that your petitioners adjudge that the public necessity and convenience require that the Commonwealth should acquire as a State highway a road leading from

in the town — city — of to in the town — city — of in the county of and which is described as follows: —

That your petitioners have caused a survey to be made, and accompany this petition with a plan and profile.

Your petitioners therefore pray that said described road may be acquired as a State highway.

Dated at this day of 189
Board of County Commissioners.

COMMONWEALTH OF MASSACHUSETTS.

To the Massachusetts Highway Commission.

Respectfully represent your petitioners that they are the mayor and aldermen of the city of in the county of ; that your petitioners adjudge that the public necessity and convenience require that the Commonwealth should acquire as a State highway a road leading from in said city, to in the town — city — of in the county of and which is described as follows: —

That your petitioners have caused a survey to be made, and accompany this petition with a plan and profile.

Your petitioners therefore pray that said described road may be acquired as a State highway.

Dated at this day of 189
*Mayor.
 Board of Aldermen.*

COMMONWEALTH OF MASSACHUSETTS.

To the Massachusetts Highway Commission.

Respectfully represent your petitioners that they are the selectmen of the town of _____ in the county of _____; that your petitioners adjudge the public necessity and convenience require that the Commonwealth should acquire as a State highway a road leading from _____ in said town, to _____ in the town — city — of _____

in the county of _____ and which is described as follows:—

That your petitioners have caused a survey to be made, and accompany this petition with a plan and profile.

Your petitioners therefore pray that said described road may be acquired as a State highway.

Board of Selectmen.

APPENDIX K.

STATEMENT SHOWING ALL PETITIONS RECEIVED,
WITH LENGTHS OF WAY PETITIONED FOR, AND
LAY-OUTS MADE, TOGETHER WITH SUMMARY
BY COUNTIES.*Barnstable County.*

COUNTY, CITY OR TOWN.	No.	Petition dated—	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			1894-95.		1896.			
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Barnstable, ¹ . . .	125	July 31, 1895,	10,548	2.00	-	-	-	-
Barnstable, ² . . .	231	Feb. 13, 1896,	10,560	2.00	-	-	-	-
Bourne, . . .	124	Jan. 29, 1895,	16,125	3.05	-	-	-	-
Brewster, . . .	118	Jan. 15, 1895,	40,982	7.76	5,280	1.00	2,220	.42
Chatham, . . .	155	April 4, 1895,	10,639	2.01	-	-	-	-
Dennis, ¹ . . .	102	Nov. 27, 1894,	22,500	4.27	5,277	1.00	2,288	.43
Dennis, ² . . .	126	Feb. 6, 1895,	17,225	3.26	-	-	-	-
Eastham, . . .	209	Aug. 5, 1895,	34,141	6.47	-	-	-	-
Harwich, . . .	106	Dec. 22, 1894,	26,150	4.95	-	-	-	-
Orleans, . . .	182	May 27, 1895,	10,440	1.98	-	-	-	-
Provincetown, . . .	186	June 4, 1895,	14,790	2.80	-	-	-	-
Sandwich, . . .	98	Nov. 23, 1894,	9,000	1.70	-	-	-	-
Truro, . . .	95	Oct. 22, 1894,	12,478	2.36	12,478	2.36	-	-
Wellfleet, . . .	229	Jan. 30, 1896,	10,203	1.93	-	-	-	-
Yarmouth, ¹ . . .	90	Sept. 28, 1894,	19,634	3.72	10,565	2.00	9,020	1.71
Yarmouth, ² . . .	100	Nov. 26, 1894,	26,900	5.10	10,740	2.04	5,006	.95
Totals, . . .		• • • •	292,315	55.36	44,340	8.40	18,534	3.51

Sixteen petitions, in thirteen towns.

Average distance petitioned for, 18,270 feet (3.46 miles).

Twelve lay-outs, in four towns; all lay-outs on town petitions.

Distance laid out, 62,874 feet (11.91 miles); average, 5,230 feet (.99 miles).

Percentage of length laid out to length petitioned for, 21.5.

¹ North county road.² South county road.

Berkshire County.

COUNTY, CITY OR TOWN.	No.	Petition dated—	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
					1894-95.		1896.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Adams,	48	July 18, 1894,	12,298	2.33	-	-	-	-
Adams,	279	July 30, 1896,	5,280	1.00	-	-	-	-
Becket,	117	Jan. 12, 1895,	10,560	2.00	-	-	-	-
Berkshire County, ¹	46	July 18, 1894,	12,298	2.33	-	-	-	-
Berkshire County, ²	47	July 18, 1894,	9,018	1.71	5,118	.97	3,177	.60
Berkshire County, ³	82	Aug. 13, 1894,	10,560	2.00	7,640	1.45	2,920	.55
Berkshire County, ⁴	83	Aug. 13, 1894,	5,200	.99	5,188	.98	-	-
Berkshire County, ⁵	170	May 10, 1895,	6,289	1.19	6,200	1.18	-	-
Berkshire County, ⁶	187	June 6, 1895,	5,300	1.00	2,652	.50	2,640	.50
Berkshire County, ⁶	275	July 25, 1896,	5,280	1.00	-	-	-	-
Berkshire County, ⁷	276	July 25, 1896,	5,280	1.00	-	-	-	-
Berkshire County, ⁸	277	July 25, 1896,	5,260	1.00	-	-	-	-
Berkshire County, ⁹	278	July 25, 1896,	5,280	1.00	-	-	-	-
Berkshire County, ⁵	293	Sept. 21, 1896,	8,580	1.62	-	-	2,704	.51
Cheshire, ¹⁰	277	- - -	5,260	1.00	-	-	-	-
Dalton,	26	June 10, 1894,	12,695	2.40	-	-	-	-
Dalton,	176	May 14, 1895,	6,300	1.20	5,459	1.03	-	-
Dalton,	238	April 1, 1896,	6,190	1.17	-	-	2,800	.53
Florida,	74	Aug. 1, 1895,	26,853	5.09	-	-	-	-
Great Barrington, ¹⁰	82	- - -	10,560	2.00	7,640	1.45	2,920	.55
Great Barrington,	267	June 18, 1896,	10,282	1.95	-	-	1,243	.24
Hancock, ¹⁰	170	- - -	6,289	1.19	6,200	1.18	-	-
Hancock, ¹⁰	293	- - -	8,580	1.62	-	-	2,704	.51
Hinsdale,	156	April 6, 1895,	5,619	1.06	-	-	-	-
Lee, ¹⁰	83	- - -	5,200	.99	5,188	.98	-	-
Lee, ¹⁰	187	- - -	5,300	1.00	2,652	.50	2,640	.50
Lee,	252	May 25, 1896,	5,280	1.00	-	-	-	-
Lenox,	178	May 16, 1895,	5,280	1.00	-	-	-	-
Lanesborough, ¹⁰	278	- - -	5,280	1.00	-	-	-	-
Monterey,	256	June 5, 1896,	5,900	1.12	-	-	-	-
Mount Washington,	92	Oct. 1, 1894,	8,300	1.58	-	-	-	-
North Adams, ¹⁰	47	- - -	9,018	1.71	5,118	.97	3,177	.60
North Adams,	254	May 27, 1896,	5,742	1.09	-	-	-	-

¹ See Adams.² See North Adams.³ See Great Barrington.⁴ See Lee.⁵ See Hancock.⁶ See Otis.⁷ See Savoy.⁸ See Cheshire.⁹ See Lanesborough.¹⁰ On county petition.

Berkshire County — Concluded.

COUNTY, CITY OR TOWN.	No.	Petition dated—	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Otis, ¹	275	— — —	5,280	1.00	—	—	—	—
Pittsfield, ²	78	Aug. 7, 1894,	24,087	4.56	5,280	1.00	—	—
Pittsfield, ³	259	June 10, 1896,	5,900	1.12	—	—	—	—
Richmond, ⁴	198	June 4, 1895,	10,462	1.98	—	—	—	—
Richmond, ⁵	248	May 9, 1896,	5,280	1.00	—	—	—	—
Savoy, ¹	276	— — —	5,280	1.00	—	—	—	—
Stockbridge,	136	Feb. 26, 1895,	10,700	2.02	—	—	—	—
West Stockbridge,	166	Sept. 30, 1895,	6,146	1.16	—	—	—	—
Williamstown,	145	March 19, 1895,	10,576	2.00	2,797	.53	3,700	.70
Windsor,	36	July 12, 1894,	42,787	8.10	—	—	—	—
Totals,	• • • •	• • • •	308,564	58.44	40,334	7.64	19,184	3.63

Thirty-three petitions (eleven county, three city, nineteen town), in two cities and twenty towns.

Average distance petitioned for, 9,350 feet (1.77 miles).

Seventeen lay-outs, in two cities and five towns.

Length laid out, 59,518 feet (11.27 miles).

Laid out on county petitions, 38,239 feet (7.24 miles); on city petitions, 5,280 feet (1 mile); on town petitions, 15,999 feet (3.03 miles); average, 3,501 feet (.66 miles).

Percentage of length laid out to length petitioned for, 19.30.

¹ On county petition.

² West Pittsfield road.

³ Dalton road.

⁴ Pittsfield east road.

⁵ Hancock road.

Bristol County.

COUNTY, CITY OR TOWN.	No.	Petition dated—	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			1894-95.		1896.			
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Acushnet, ¹ . . .	96	Oct. 24, 1894,	35,500	6.73	-	-	-	-
Acushnet, ² . . .	97	Oct. 24, 1894,	6,326	1.20	-	-	-	-
Attleborough, ³ . . .	183	May 29, 1895,	14,153	2.68	-	-	-	-
Attleborough, ⁴ . . .	184	May 29, 1895,	5,122	.97	-	-	-	-
Attleborough, ⁵ . . .	268	June 18, 1896,	14,246	2.70	-	-	-	-
Berkley, . . .	281	Aug. 3, 1896,	22,728	4.30	-	-	-	-
Bristol County, ⁶ . . .	53	July 24, 1894,	48,070	9.11	15,840	3.00	-	-
Dartmouth, ⁷ . . .	22	July 9, 1894,	24,000	4.54	-	-	-	-
Dighton, ⁸ . . .	150	March 26, 1895,	24,576	4.65	-	-	-	-
Dighton, ⁹ . . .	226	Jan. 2, 1896,	8,261	1.56	-	-	-	-
Easton, . . .	139	March 1, 1895,	39,000	7.39	-	-	-	-
Fairhaven, . . .	31	July 10, 1894,	20,100	3.80	7,653	1.45	-	-
New Bedford, . . .	191	June 18, 1895,	2,950	.56	-	-	-	-
North Attleborough, .	18	July 5, 1894,	25,500	4.83	8,792	1.66	5,911	1.12
Raynham, . . .	134	Feb. 23, 1895,	23,000	4.36	-	-	-	-
Rehoboth, . . .	132	Feb. 20, 1895,	29,186	5.53	5,273	1.00	2,920	.55
Seekonk, . . .	127	Feb. 6, 1895,	14,591	2.76	-	-	-	-
Somerset, . . .	147	March 30, 1895,	29,800	5.64	4,517	.86	2,970	.56
Swansea, . . .	235	March 10, 1896,	36,515	6.92	-	-	-	-
Taunton, ¹⁰ . . .	171	May 11, 1895,	25,864	4.89	-	-	-	-
Taunton, ¹¹ . . .	179	May 16, 1895,	23,752	4.50	4,000	.76	2,300	.44
Taunton, ^{12, 13} . . .	180	May 19, 1895,	13,200	2.50	-	-	-	-
Westport, ¹⁴ . . .	53	-	24,070	4.57	15,840	3.00	-	-
Totals, . . .	. . .	. . .	456,114	86.38	46,075	8.73	14,101	2.67

Twenty-two petitions (one county, four city and seventeen town), in two cities and fourteen towns.

Average distance petitioned for, 20,733 feet (3.93 miles).

Fourteen lay-outs, in one city and five towns.

Length laid out, 60,176 feet (11.40 miles); average, 4,298 feet (.83 mile). Laid out on county petition, 15,840 feet (3 miles); on town petitions, 38,036 feet (7.20 miles); on city petition, 6,300 feet (1.20 miles).

Percentage of distance laid out to distance petitioned for, 13.19.

¹ New Bedford-Boston road.

⁷ Duplicate of county petition.

² Fairhaven road.

⁸ Somerset Avenue.

³ Washington Street (turnpike).

⁹ Providence-Taunton turnpike.

⁴ North Avenue.

¹⁰ Somerset Avenue and Dean Street.

⁵ Washington and Horton Streets. To Hor-

¹¹ Winthrop Street.

ton Street is duplicate of petition No.

¹² Broadway (Boston Turnpike).

183; Horton Street scales, 7,920 feet

¹³ No plan; distance scaled on map.

(1.50 miles).

¹⁴ On county petition.

⁶ See Dartmouth and Westport.

Nantucket County.

COUNTY, CITY OR TOWN.	No.	Petition dated—	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			1894-95.		1896.			
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Nantucket, . . .	11	July 3, 1894,	34,185	6.50	13,560	2.58	6,070	1.15

One petition, in one town. Five lay-outs, in one town.

Length laid out, 19,630 feet (3.73 miles).

Percentage of length laid out to length petitioned for, 57.38.

County of Dukes County.

COUNTY, CITY OR TOWN.	No.	Petition dated—	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			1894-95.		1896.			
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Chilmark, . . .	12	July 3, 1894,	41,237	7.81	—	—	—	—
Cottage City, ¹ . . .	7	— — —	13,117	2.48	10,568	2.00	1,970	.37
Dukes County, ² . . .	7	July 2, 1894,	26,217	4.96	10,568	2.00	1,970	.37
Edgartown, ¹ . . .	7	— — —	13,100	2.48	—	—	—	—
Tisbury, . . .	3	June 28, 1894,	10,609	2.01	10,194	1.93	—	—
West Tisbury, . . .	4	June 28, 1894,	28,441	5.39	5,280	1.00	7,920	1.50
West Tisbury, ³ . . .	255	May 29, 1896,	6,212	1.18	—	—	—	—
Totals,	• • • •	• • • •	112,716	21.35	26,042	4.93	9,890	1.87

Five petitions (one county and four town), in five towns.

Six lay-outs, in three towns.

Length laid out, 35,932 feet (6.80 miles); average, 6,988 feet (1.13 miles).

Laid out on county petition, 12,538 feet (2.38 miles); on town petitions, 23,394 feet (4.42 miles).

Percentage of length laid out to length petitioned for, 31.85.

¹ On county petition.

² See Cottage City and Edgartown.

³ Petition for change of location.

Essex County.

COUNTY, CITY OR TOWN.	No.	Petition dated—	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	1894-95.	1896.	Feet.	Miles.
Amesbury,	203	July 22, 1895,	27,997	5.30	—	—	—	—
Andover,	20	July 6, 1894,	31,400	5.95	3,026	.58	3,360	.64
Beverly, ¹	64	— — —	13,900	2.64	7,806	1.47	—	—
Essex County, ²	64	July 30, 1894,	53,800	10.19	7,806	1.47	—	—
Gloucester, ³	28	July 10, 1894,	9,650	1.83	8,452	1.60	—	—
Gloucester, ^{4,5}	110	Jan. 1, 1895,	54,120	10.25	—	—	—	—
Groveland,	211	Aug. 8, 1895,	23,948	4.53	—	—	—	—
Hamilton, ¹	64	— — —	18,100	3.43	—	—	—	—
Haverhill,	297	Nov. 4, 1896,	13,888	2.63	—	—	—	—
Ipswich, ¹	64	— — —	12,700	2.40	—	—	—	—
Ipswich, ⁶	239	April 4, 1896,	11,900	2.25	—	—	—	—
Lawrence, ⁵	76	Aug. 2, 1894,	2,640	.50	—	—	—	—
Lawrence, ^{5,7}	245	May 4, 1896,	4,660	.88	—	—	—	—
Lawrence, ^{5,8}	284	Aug. 25, 1896,	2,300	.44	—	—	—	—
Lawrence, ^{5,9}	255	Aug. 25, 1896,	1,750	.33	—	—	—	—
Lawrence, ¹⁰	290	Sept. 11, 1896,	1,408	.27	—	—	1,408	.27
Manchester,	167	May 1, 1895,	5,280	1.00	—	—	—	—
Merrimac,	204	July 26, 1895,	15,134	2.87	—	—	—	—
Methuen,	287	Aug. 31, 1896,	20,184	3.82	—	—	5,478	1.04
Newbury,	197	July 2, 1895,	22,388	4.24	—	—	—	—
Newburyport,	196	July 1, 1895,	10,100	1.91	—	—	3,641	.69
North Andover,	272	July 1, 1896,	10,186	1.93	—	—	—	—
Rockport,	135	Feb. 23, 1895,	5,736	1.08	—	—	—	—
Rowley,	242	April 23, 1896,	19,270	3.65	—	—	—	—
Salisbury,	243	April 27, 1895,	10,560	2.00	—	—	—	—
Saugus,	34	July 11, 1894,	8,811	1.67	—	—	—	—
Wenham, ¹	64	— — —	9,100	1.73	—	—	—	—
West Newbury,	101	Nov. 26, 1894,	27,017	5.11	5,211	.99	5,206	.98
West Newbury,	206	July 29, 1895,	4,000	.76	—	—	—	—
Totals,			398,127	75.40	24,495	4.64	19,093	3.62

Twenty-five petitions (one county, nine city and fifteen town), in five cities and sixteen towns.

Average distance petitioned for, 15,928 feet (3.02 miles).

Ten lay-outs, in four cities and three towns.

Length laid out, 43,588 feet (8.26 miles); average, 4,359 feet (.82 mile). Laid out on county petition, 7,806 feet (1.47 miles); on town petitions, 22,281 feet (4.23 miles); on city petitions, 13,501 feet (2.56 miles).

Percentage of length laid out to length petitioned for, 10.96.

¹ On county petition.

² See Beverly, Hamilton, Ipswich and Wenham.

³ Western Avenue.

⁴ Essex Avenue, Washington Street and Rockport Road.

⁵ No plan; distance scaled on map.

⁶ North of Ipswich River to Rowley line.

⁷ South Broadway to Andover line.

⁸ East Haverhill Street to Methuen line.

⁹ Prospect Street to Methuen line.

¹⁰ Jackson Street.

Franklin County.

COUNTY, CITY OR TOWN.	No.	Petition dated—	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			1894-95.		1896.			
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Ashfield,	195	June 26, 1895,	5,300	1.00	-	-	-	-
Buckland, ¹	38	July 14, 1894,	1,152	.22	796	.15	-	-
Buckland,	112	Jan. 5, 1895,	5,280	1.00	5,308	1.00	-	-
Buckland,	224	Dec. 28, 1895,	5,280	1.00	-	-	2,439	.46
Charlemont,	120	Jan. 18, 1895,	7,500	1.42	-	-	-	-
Colrain, ¹	43	July 17, 1894,	1,062	.20	-	-	-	-
Colrain,	133	Feb. 20, 1895,	12,438	2.36	-	-	-	-
Couway,	215	Sept. 4, 1895,	14,147	2.68	-	-	-	-
Deerfield, ²	24	- - -	9,400	1.79	8,093	1.53	-	-
Erving, ¹	152	March 29, 1895,	10,717	2.03	-	-	-	-
Franklin County, ³ . .	24	July 9, 1894,	69,170	13.10	25,161	4.77	2,416	.46
Gill,	130	Feb. 7, 1895,	10,520	1.99	-	-	-	-
Greenfield, ⁴	188	June 10, 1895,	23,700	4.49	-	-	-	-
Montague,	304	Dec. 18, 1896,	10,560	2.00	-	-	-	-
New Salem,	258	June 8, 1896,	27,300	5.17	-	-	-	-
Orange, ¹	6	July 2, 1894,	30,550	5.74	9,230	1.75	-	-
Orange, ¹	103	Dec. 10, 1894,	5,280	1.00	-	-	-	-
Orange, ¹	301	Nov. 27, 1896,	2,300	.43	-	-	-	-
Shelburne, ^{1,5}	35	July 11, 1894,	12,138	2.30	7,042	1.33	2,416	.46
Shelburne, ⁶	227	Jan. 13, 1896,	5,300	1.00	-	-	-	-
Sunderland, ¹	52	July 24, 1894,	4,151	.80	-	-	-	-
Totals,			195,433	37.01	30,469	5.77	4,855	.92

Twenty petitions (one county and nineteen town), in fourteen towns.

Average distance petitioned for, 9,772 feet (1.85 miles).

Ten lay-outs, in four towns; average distance laid out, 3,532 feet (.67 mile).

Length laid out, 35,324 feet (6.69 miles).

Percentage of length laid out to length petitioned for, 18.08.

¹ Duplicate of county petition.

² On county petition.

³ See Buckland, Colrain, Deerfield, Erving, Orange, Shelburne and Sunderland.

⁴ Plan for 5,300 feet, balance scaled on map.

⁵ Colrain road.

⁶ Greenfield road.

Hampden County.

COUNTY, CITY OR TOWN.	No.	Petition dated—	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	1894-95.		1896.	
					Feet.	Miles.	Feet.	Miles.
Blandford, . . .	216	Sept. 7, 1895,	13,337	2.54	—	—	—	—
Brimfield, ¹ . . .	40	July 6, 1894,	36,370	6.89	—	—	—	—
Brimfield, ^{2,3} . . .	131	—	9,855	1.77	—	—	—	—
Chester, . . .	104	Dec. 11, 1894,	5,280	1.00	—	—	—	—
Chicopee, . . .	223	Dec. 28, 1895,	5,700	1.08	—	—	—	—
East Longmeadow, .	202	July 11, 1895,	25,426	4.81	—	—	—	—
Granville, . . .	87	Sept. 6, 1894,	9,216	1.75	—	—	—	—
Hampden, . . .	201	July 11, 1895,	18,031	3.41	—	—	—	—
Hampden County, ⁴	19	July 6, 1894,	100,480	19.03	24,169	4.58	11,876	2.25
Hampden County, ⁵	131	Feb. 12, 1895,	90,064	17.06	5,276	1.00	—	—
Hampden County, ⁶	241	April 23, 1896,	2,400	.46	—	—	—	—
Hampden County, ⁷	273	July 3, 1896,	5,300	1.00	—	—	—	—
Holyoke, . . .	273	—	5,300	1.00	—	—	—	—
Ludlow, . . .	236	March 11, 1896,	14,831	2.80	—	—	—	—
Monson, ⁸ . . .	57	July 26, 1894,	14,960	2.83	4,933	.93	—	—
Monson, ^{1,9} . . .	131	—	6,925	1.31	—	—	—	—
Palmer, ¹ . . .	131	—	46,034	8.72	—	—	—	—
Russell, ¹ . . .	19	—	35,380	6.70	12,207	2.31	6,089	1.15
Wales, . . .	41	July 16, 1894,	25,922	4.91	—	—	—	—
Westfield, ¹ . . .	19	—	40,900	7.75	6,708	1.27	2,987	.57
West Springfield, ¹⁰	113	Jan. 8, 1895,	24,200	5.58	5,254	1.00	2,800	.53
West Springfield, ¹	241	—	2,400	.46	—	—	—	—
Wilbraham, ¹ . . .	131	—	27,750	5.26	5,276	1.00	—	—
Wilbraham, . . .	247	May 8, 1896,	4,140	.78	—	—	3,073	.58
Totals, . . .	. . .	. . .	371,457	70.85	34,378	6.51	14,949	2.83

Sixteen petitions (four county, one city and eleven town), in two cities and fourteen towns. Average distance petitioned for, 23,216 feet (4.40 miles).

Fifteen lay-outs, in five towns.

Length laid out, 49,327 feet (9.34 miles); average, 3,288 feet (.62 mile).

Laid out on county petitions, 41,821 feet (7.82 miles).

Laid out on town petitions, 8,006 feet (1.52 miles).

Percentage of length laid out to length petitioned for, 13.28.

¹ Road to Brimfield Centre.

² River road.

³ See Brimfield, Monson, Palmer and Wilbraham.

⁴ See Holyoke.

⁵ River road.

² On county petition.

⁴ See Westfield, Russell and West Springfield.

⁶ See West Springfield (Agawam road).

⁸ Road from Palmer to Monson.

¹⁰ Duplicate of county petition.

Hampshire County.

COUNTY, CITY OR TOWN.	No.	Petition dated—	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	1894-95.		1896.	
Amherst, . . .	181	May 18, 1895,	5,356	1.02	—	—	—	—
Belchertown, . . .	220	Nov. 18, 1895,	5,280	1.00	—	—	—	—
Belchertown, . . .	282	Aug. 6, 1896,	5,280	1.00	—	—	—	—
Chesterfield, ¹ . . .	128	Feb. 6, 1895,	3,930	.74	—	—	—	—
Cummington, ¹ . . .	27	July 10, 1894,	55,053	10.43	—	—	—	—
Easthampton, ² . . .	114	Jan. 10, 1895,	5,854	1.11	—	—	—	—
Easthampton, ^{1, 3} . . .	189	July 10, 1895,	6,300	1.29	5,280	1.00	1,683	.32
Enfield, . . .	283	Aug. 25, 1896,	9,593	1.81	—	—	—	—
Goshen, ¹ . . .	2	June 28, 1894,	29,480	5.58	10,058	1.91	—	—
Granby, ⁴ . . .	5	—	3,347	.63	3,347	.63	—	—
Granby, . . .	289	Sept. 9, 1896,	10,700	2.03	—	—	—	—
Greenwich, . . .	295	Oct. 17, 1896,	5,464	1.03	—	—	—	—
Hadley, ¹ . . .	94	Oct. 20, 1894,	5,667	1.08	5,676	1.08	—	—
Hadley, . . .	200	July 11, 1895,	4,133	.78	—	—	2,150	.41
Hadley, . . .	284	Aug. 27, 1896,	14,766	2.80	—	—	—	—
Hampshire County, ⁵ .	5	June 29, 1894,	154,192	29.19	29,998	5.68	4,783	.90
Hatfield, . . .	164	April 23, 1895,	2,500	.47	—	—	—	—
Hatfield, . . .	165	April 23, 1895,	5,280	1.00	—	—	—	—
Huntington, . . .	99	Nov. 24, 1894,	14,408	2.73	3,553	.67	1,783	.34
Middlefield, . . .	177	May 14, 1895,	5,400	1.03	—	—	—	—
Northampton, ¹ . . .	67	July 31, 1894,	2,997	.56	2,997	.56	—	—
Northampton, ¹ . . .	194	June 25, 1895,	5,280	1.00	—	—	—	—
South Hadley, ⁴ . . .	5	—	15,571	2.95	2,640	.50	—	—
South Hadley, ¹ . . .	288	Sept. 3, 1896,	8,816	1.67	—	—	—	—
Southampton, . . .	253	May 25, 1896,	5,280	1.00	—	—	—	—
Ware, . . .	205	July 29, 1895,	4,100	.77	—	—	—	—
Williamsburg, ⁴ . . .	5	—	26,063	4.94	—	—	3,100	.58
Williamsburg, ^{1, 6} . . .	129	Feb. 6, 1895,	11,908	2.26	—	—	—	—
Williamsburg, ^{1, 7} . . .	249	May 11, 1896,	5,695	1.08	—	—	—	—
Totals, . . .	. . .	. . .	257,586	48.78	33,551	6.35	8,716	1.65

Twenty-six petitions (one county, two city, twenty-three town), in one city and seventeen towns.

Thirteen lay-outs, in one city and seven towns.

Length laid out, 42,267 feet (8.00 miles). Average length laid out, 3,251 feet (.62 mile).

Average length petitioned for, 9,907 feet (1.88 miles).

Laid out on county petition, 34,781 feet (6.58 miles).

Laid out on town petitions, 7,486 feet (1.42 miles).

Percentage of length laid out to length petitioned for, 16.42.

¹ Duplicate of county petition.

² Holyoke Street.

³ Northampton road.

⁴ On county petition.

⁵ See Chesterfield, Cummington, Easthampton, Goshen, Granby, Hadley, Northampton, South Hadley and Williamsburg.

⁶ Chesterfield road.

⁷ Goshen road.

Middlesex County.

COUNTY, CITY OR TOWN.	No.	Petition dated—	LENGTH PETYONED FOR.		LENGTH LAID OUT.			
					1894-95.		1896.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Acton, ¹	119	Jan. 7, 1895,	9,158	1.73	-	-	-	-
Acton, ¹	138	Feb. 28, 1895,	12,129	2.30	-	-	-	-
Acton, ²	233	- - -	21,922	4.15	-	-	-	-
Ashby,	1	June 27, 1894,	18,625	3.53	8,488	1.61	1,200	.23
Ayer,	225	Jan. 1, 1896,	15,546	2.95	-	-	-	-
Bedford,	175	May 14, 1895,	19,636	3.72	-	-	-	-
Billerica,	264	June 13, 1896,	18,490	3.50	-	-	-	-
Boxborough, ²	233	- - -	17,508	3.32	-	-	-	-
Carlisle,	109	Dec. 26, 1894,	21,531	4.08	-	-	-	-
Chelmsford, ^{3,4}	50	July 20, 1894,	5,583	1.06	-	-	-	-
Chelmsford, ^{2,12}	266	- - -	6,030	1.15	-	-	-	-
Concord,	81	Sept. 11, 1894,	8,550	1.62	-	-	-	-
Dunstable,	291	Sept. 17, 1896,	8,778	1.66	-	-	-	-
Framingham,	303	Dec. 17, 1896,	8,296	1.57	-	-	-	-
Groton, ⁵	105	Dec. 17, 1894,	40,215	7.61	-	-	-	-
Groton, ⁶	219	Nov. 14, 1895,	23,140	4.38	-	-	-	-
Lexington,	79	Aug. 8, 1894,	18,300	3.46	4,020	.76	3,498	.66
Lincoln,	80	Aug. 8, 1894,	10,850	2.05	5,290	1.00	3,561	.68
Lowell, ^{3,4}	55	July 25, 1894,	7,011	1.33	-	-	-	-
Lowell, ²	44	- - -	5,248	1.00	-	-	-	-
Littleton,	218	Nov. 14, 1895,	12,110	2.29	-	-	-	-
Marlborough, ⁷	143	March 15, 1895,	12,688	2.40	-	-	-	-
Marlborough, ⁸	271	June 26, 1896,	17,135	3.25	-	-	-	-
Medford, ⁴	265	June 13, 1896,	4,918	.93	-	-	-	-
Middlesex County, ⁹	44	July 17, 1894,	20,800	3.94	7,945	1.50	7,643	1.45
Middlesex County, ¹⁰	45	July 17, 1894,	12,594	2.39	-	-	-	-
Middlesex County, ¹¹	233	Feb. 25, 1896,	39,430	7.47	-	-	-	-
Middlesex County, ¹²	266	June 15, 1896,	6,030	1.15	-	-	-	-
Middlesex County, ¹³	274	July 13, 1896,	11,363	2.15	-	-	-	-
Natick,	251	May 21, 1896,	6,813	1.29	-	-	-	-
North Reading,	107	Dec. 24, 1894,	31,060	5.88	-	-	-	-
Pepperell,	299	Nov. 11, 1896,	18,700	3.54	-	-	-	-

¹ Littleton Road.² On county petition.³ Princeton Street.⁴ Duplicate of county petition.⁵ Fitchburg-Lowell road.⁶ Great road.⁷ Northborough road.⁸ Sudbury road.⁹ Tyngsborough road.¹⁰ Chelmsford road.¹¹ Acton-Boxborough road.¹² Truant school road.¹³ Medford-Stoneham road.¹⁴ Maiu east and west road.

Middlesex County — Concluded.

COUNTY, CITY OR TOWN.	No.	Petition dated—	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	1894-95.		1896.	
Reading, . . .	157	April 10, 1895,	23,100	4.38	—	—	—	—
Sherborn, . . .	250	May 14, 1896,	5,500	1.04	—	—	—	—
Stoneham, ¹ . . .	280	July 30, 1896,	6,450	1.22	—	—	—	—
Sudbury, ² . . .	214	Aug. 24, 1895,	5,300	1.00	—	—	—	—
Sudbury, ² . . .	230	Feb. 16, 1896,	20,409	3.87	—	—	—	—
Tewksbury, . . .	257	June 5, 1896,	14,770	2.80	—	—	—	—
Townsend, . . .	149	March 21, 1895,	16,830	3.19	—	—	3,459	.65
Tyngsborough, ³ . .	44	—	15,552	2.94	7,945	1.50	7,643	1.45
Watertown, . . .	151	March 27, 1895,	17,736	3.36	4,019	.76	453	.09
Wayland, . . .	212	Aug. 10, 1895,	15,450	2.93	—	—	—	—
Westford, . . .	115	Jan. 10, 1895,	21,900	4.15	—	—	—	—
Winchester, . . .	244	April 28, 1896,	10,300	1.95	—	—	—	—
Totals, . . . .	. . . .	. . . .	573,267	108.57	29,762	5.63	19,814	3.76

Thirty-nine petitions (five county, four city, thirty town), in three cities and twenty-nine towns.

Twelve lay-outs, in six towns.

Average distance petitioned for, 14,698 feet (2.75 miles).

Length laid out, 49,576 feet (9.39 miles): average, 4,131 feet (.78 mile); on county petitions, 15,588 feet (2.95 miles); on town petitions, 33,988 feet (6.44 miles).

Percentage of length laid out to length petitioned for, 8.65.

¹ Duplicate of county petition. ² Main east and west road. ³ On county petitions.

Norfolk County.

COUNTY, CITY OR TOWN.	No.	Petition dated—	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			1894-95.		1896.			
			Feet.	Miles.	Feet.	Miles.		
Bellingham, . . .	173	May 13, 1895,	3,900	.74	-	-	-	-
Braintree, . . .	116	Jan. 10, 1895,	6,700	1.27	-	-	-	-
Cohasset, . . .	158	April 12, 1895,	11,300	2.14	-	-	-	-
Dedham, . . .	307	Dec. 31, 1896,	3,900	.75	-	-	-	-
Foxborough, ^{1,2} . . .	123	Jan. 20, 1895,	29,040	5.50	-	-	-	-
Foxborough, . . .	163	April 24, 1895,	5,840	1.11	-	-	-	-
Franklin, . . .	298	Nov. 6, 1896,	9,227	1.75	-	-	-	-
Holbrook, . . .	9	July 10, 1894,	11,848	2.24	2,488	.48	3,329	.63
Milton, . . .	190	June 15, 1895,	5,730	1.09	-	-	-	-
Needham, . . .	154	April 2, 1895,	9,050	1.71	-	-	-	-
Norfolk, . . .	88	Sept. 21, 1894,	7,676	1.45	7,676	1.45	-	-
Norwood, . . .	51	July 21, 1894,	18,747	3.55	3,198	.61	2,153	.41
Quiney, ³ . . .	237	March 18, 1896,	9,920	1.88	-	-	-	-
Quiney, ⁴ . . .	292	Sept. 17, 1896,	7,400	1.40	-	-	-	-
Randolph, . . .	208	Aug. 3, 1895,	9,050	1.71	-	-	-	-
Sharon, . . .	159	April 12, 1895,	28,713	5.44	-	-	-	-
Stoughton, . . .	228	Jan. 15, 1896,	20,538	3.89	-	-	-	-
Walpole, . . .	77	Aug. 4, 1894,	30,300	5.74	8,502	1.61	-	-
Weymouth, ⁵ . . .	59	July 27, 1894,	9,400	1.78	2,216	.41	3,921	.75
Weymouth, ⁶ . . .	63	July 30, 1894,	1,330	.25	1,330	.25	-	-
Wrentham, . . .	32	July 10, 1894,	38,150	7.23	8,540	1.62	-	-
Totals,			277,759	52.61	33,950	6.43	9,403	1.78

Twenty-one petitions (two city and nineteen town), in one city and seventeen towns.

Average distance petitioned for, 13,227 feet (2.50 miles).

Twelve lay-outs, in six towns; all on town petitions.

Length laid out, 43,353 feet (8.21 miles); average, 3,613 feet (.68 mile).

Percentage of length laid out to length petitioned for, 15.61.

¹ Withdrawn; No. 163 substituted.

² No plan; distance scaled on map.

³ Washington Street.

⁴ Randolph Avenue.

⁵ Bridge Street.

⁶ Ann Street.

Plymouth County.

COUNTY, CITY OR TOWN.	No	Petition dated—	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			1894-95.		1896.			
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Abington,	58	July 27, 1894,	8,700	1.66	-	-	-	-
Abington,	192	June 19, 1895,	10,300	1.95	-	-	-	-
Bridgewater,	217	Nov. 14, 1895,	6,600	1.25	-	-	-	-
Brockton,	61	July 27, 1894,	5,525	1.05	-	-	-	-
Brockton,	270	June 22, 1896,	5,037	.96	-	-	-	-
Duxbury,	70	July 31, 1894,	33,000	6.25	5,540	1.05	-	-
East Bridgewater,	240	April 8, 1896,	6,300	1.19	-	-	-	-
Halifax,	54	July 24, 1894,	23,463	4.44	-	-	-	-
Hanover,	66	July 30, 1894,	24,157	4.58	-	-	-	-
Hanson, ¹	262	June 12, 1896,	5,280	1.00	-	-	-	-
Hanson, ²	263	June 12, 1896,	5,280	1.00	-	-	-	-
Hingham,	8	July 3, 1894,	27,655	5.24	7,505	1.42	3,880	.73
Lakeville,	174	May 14, 1895,	5,300	1.00	-	-	-	-
Marion,	29	July 10, 1894,	27,248	5.16	7,780	1.48	-	-
Marshfield,	71	July 31, 1894,	40,400	7.65	2,640	.50	2,582	.49
Mattapoisett,	30	July 10, 1894,	24,992	4.73	6,134	1.16	-	-
Middleborough, ³	68	July 31, 1894,	77,169	14.62	7,270	1.37	2,676	.51
Norwell,	246	May 5, 1896,	5,923	1.12	-	-	-	-
Pembroke,	234	Feb. 27, 1896,	5,280	1.00	-	-	-	-
Plymouth, ⁴	72	July 31, 1894,	90,420	17.13	7,509	1.42	-	-
Plymouth, ⁵	269	June 22, 1896,	5,846	1.11	-	-	5,846	1.11
Plympton,	121	Jan. 22, 1895,	5,380	1.02	-	-	-	-
Rochester,	172	May 13, 1895,	22,108	4.19	-	-	-	-
Rockland,	75	Aug. 1, 1894,	6,900	1.30	-	-	-	-
Scituate,	69	July 31, 1894,	28,500	5.39	6,139	1.17	-	-
Wareham,	42	July 16, 1894,	60,100	11.38	-	-	3,014	.57
West Bridgewater,	221	Dec. 4, 1895,	17,100	3.24	-	-	-	-
Whitman,	65	July 30, 1894,	8,900	1.68	7,883	1.49	1,074	.20
Totals,			592,863	112.28	58,400	11.06	19,072	3.61

Twenty-eight petitions (two city and twenty-six town), in one city and twenty-three towns. Average distance petitioned for, 21,174 feet (4.01 miles).

Length laid out, 77,472 feet (14.67 miles); average, 3,228 feet (.61 mile).

Twenty-five lay-outs, in ten towns; all lay-outs have been made on town petitions.

Percentage of distance laid out to distance petitioned for, 13.06.

¹ Main Street.

² Whitman Street.

³ Plan for 10,732 feet; balance scaled on map.

⁴ Plan for 8,211 feet; balance scaled on map. Shore road.

⁵ Pine Hills road.

Suffolk County.

COUNTY, CITY OR TOWN.	No.	Petition dated—	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			1894-95.		1896.			
			Feet.	Miles.	Feet.	Miles.		
Chelsea,	56	July 25, 1894,	6,000	1.14	-	-	-	-
Revere,	60	July 27, 1894,	11,475	2.17	-	-	-	-
Winthrop,	73	July 31, 1894,	18,100	3.42	-	-	-	-
Totals,			35,575	6.73	-	-	-	-

Three petitions, in one city and two towns.

No lay-outs.

Worcester County.

COUNTY, CITY OR TOWN.	No.	Petition dated—	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			1894-95.		1896.			
			Feet.	Miles.	Feet.	Miles.		
Athol,	37	July 12, 1894,	16,800	3.18	5,280	1.00	3,195	.61
Auburn,	148	March 20, 1895,	12,100	2.29	4,004	.76	2,900	.55
Barre,	146	March 19, 1895,	15,286	2.89	-	-	-	-
Blackstone,	140	March 2, 1895,	7,700	1.46	-	-	-	-
Bolton,	185	June 3, 1895,	5,280	1.00	-	-	-	-
Brookfield,	111	Jan. 2, 1895,	5,972	1.13	-	-	-	-
Brookfield,	300	Nov. 27, 1896,	22,025	4.17	-	-	-	-
Charlton,	261	June 11, 1896,	10,700	2.03	-	-	-	-
Dana,	294	Sept. 24, 1896,	10,560	2.00	-	-	-	-
Fitchburg, ¹	17	July 5, 1894,	5,493	1.04	5,133	.97	-	-
Fitchburg, ²	62	July 30, 1894,	20,800	3.94	-	-	-	-
Fitchburg, ^{3, 4}	93	Oct. 3, 1894,	10,560	2.00	-	-	-	-
Gardner,	13	July 3, 1894,	20,656	5.62	-	-	-	-
Grafton,	213	Aug. 15, 1895,	16,971	3.21	-	-	-	-
Hardwick,	207	July 31, 1895,	5,357	1.01	-	-	-	-
Harvard,	260	June 11, 1896,	25,775	4.88	-	-	-	-
Holden,	10	July 3, 1894,	27,920	5.29	7,811	1.48	3,386	.64
Hopedale,	144	March 16, 1895,	6,040	1.14	-	-	-	-
Hubbardston,	232	Feb. 24, 1896,	10,560	2.00	-	-	-	-
Lancaster,	137	Feb. 28, 1895,	24,808	4.70	-	-	-	-
Leicester,	25	July 9, 1894,	28,110	5.32	10,608	2.01	3,310	.63
Leominster, ⁴	91	Sept. 29, 1894,	26,400	5.00	-	-	-	-
Lunenberg,	16	July 5, 1894,	30,772	5.83	-	-	-	-

¹ Westminster road.³ Leominster road.² Ashby road.⁴ No plan; distance scaled on map.

Worcester County—Concluded.

COUNTY, CITY OR TOWN.	No.	Petition dated—	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	1894-95.		1896.	
Mendon, . . .	84	Aug. 20, 1894,	18,432	3.49	—	—	—	—
New Braintree, . .	210	Aug. 6, 1895,	939	.18	—	—	—	—
Northborough, ¹ . .	122	Jan. 24, 1895,	3,834	.73	—	—	—	—
Northborough, ² . .	153	April 1, 1895,	11,000	2.08	—	—	—	—
Oakham, . . .	199	July 11, 1895,	15,045	2.85	—	—	—	—
Oxford, . . .	108	Dec. 24, 1894,	33,550	6.35	—	—	—	—
Paxton, . . .	33	July 10, 1894,	28,500	5.40	10,478	1.99	1,958	.37
Petersham, . . .	296	Oct. 22, 1896,	23,744	4.49	—	—	—	—
Phillipston, . . .	14	July 3, 1894,	17,400	3.30	—	—	—	—
Princeton, . . .	193	June 22, 1895,	14,221	2.69	—	—	—	—
Royalston, . . .	302	Dec. 7, 1896,	23,195	4.39	—	—	—	—
Rutland, ³ . . .	141	March 5, 1895,	24,581	4.65	—	—	—	—
Rutland, ⁴ . . .	142	March 5, 1895,	24,268	4.59	—	—	—	—
Shrewsbury, . . .	21	July 6, 1894,	11,000	2.08	5,291	1.00	3,920	.74
Southborough, . .	161	April 18, 1895,	5,300	1.00	—	—	—	—
Spencer, . . .	49	July 19, 1894,	23,418	4.44	—	—	—	—
Sterling, . . .	168	May 1, 1895,	5,280	1.00	—	—	—	—
Sturbridge, . . .	169	May 7, 1895,	12,600	2.39	—	—	—	—
Sutton, . . .	85	Aug. 25, 1894,	6,096	1.16	—	—	—	—
Templeton, . . .	86	Sept. 1, 1894,	31,668	6.00	—	—	—	—
Upton, . . .	305	Dec. 18, 1896,	24,743	4.69	—	—	—	—
Uxbridge, . . .	89	Sept. 28, 1894,	15,759	2.99	—	—	—	—
Warren, ⁵ . . .	15	July 5, 1894,	28,020	5.31	—	—	5,370	1.02
Warren, ⁶ . . .	39	July 16, 1894,	18,868	3.57	—	—	—	—
Westborough, ⁷ . .	160	April 14, 1895,	1,100	.20	—	—	—	—
Westborouhg, ⁸ . .	306	Dec. 30, 1896,	5,300	1.00	—	—	—	—
West Brookfield, . .	222	Dec. 5, 1895,	800	.15	—	—	—	—
Westminster, . . .	23	July 9, 1894,	30,590	5.79	6,495	1.24	2,455	.46
Worcester, . . .	162	April 22, 1895,	7,636	1.44	—	—	5,300	1.00
Totals, . . .			842,532	159.57	55,100	10.43	31,800	6.02

Fifty-two petitions (four city and forty-eight town), in two cities and forty-three towns. Average distance petitioned for, 16,410 feet (3.11 miles).

Twenty-five lay-outs, in two cities and eight towns.

Length laid out, 86,900 feet (16.45 miles); average, 3,476 feet (.66 mile).

Laid out on city petitions, 10,433 feet (1.98 miles).

Laid out on town petitions, 76,467 feet (14.47 miles).

Percentage of length laid out to length petitioned for, 10.31.

¹ Westborough Hospital road.

² Marlborough-Worcester road.

³ Holden road.

⁴ Paxton road.

⁵ Worcester-Springfield road.

⁶ Road to Brimfield and Wales.

⁷ Hospital road.

⁸ Agricultural grounds road.

*Statement showing Number of County, City and Town Petitions,
Distribution of Petitions among Municipalities, and Number
of Cities and Towns in which Lay-outs have been made, by
Counties.*

COUNTIES.	PETITIONS RECEIVED FROM —				PETITIONS SITUATED IN —			LAY-OUTS MADE IN —			Number of Lay- outs.
	Counties.	Cities.	Towns.	Total.	Cities.	Towns.	Total.	Cities.	Towns.	Total.	
Barnstable, . . .	-	-	16	16	-	13	13	-	4	4	12
Berkshire, . . .	11	3	19	33	2	20	22	2	5	7	17
Bristol, . . .	1	4	17	22	2	14	16	1	5	6	14
Dukes, . . .	1	-	4	5	-	5	5	-	3	3	6
Essex, . . .	1	9	15	25	5	16	21	4	3	7	10
Franklin, . . .	1	-	19	20	-	14	14	-	4	4	10
Hampden, . . .	4	1	11	16	2	14	16	-	5	5	15
Hampshire, . . .	1	2	23	26	1	17	18	1	7	8	13
Middlesex, . . .	5	4	30	39	3	29	32	-	6	6	12
Nantucket, . . .	1	-	-	1	-	1	1	-	1	1	5
Norfolk, . . .	-	2	19	21	1	17	18	-	6	6	12
Plymouth, . . .	-	2	26	28	1	23	24	-	10	10	25
Suffolk, . . .	-	1	2	3	1	2	3	-	-	-	-
Worcester, . . .	-	4	48	52	2	43	45	2	8	10	25
Totals, . . .	26	32	249	307	20	228	248	10	67	77	176

Summary of Lengths petitioned for and laid out, by Counties, together with Percentage of Lengths laid out to Lengths petitioned for.

COUNTIES.	LENGTHS PETITIONED FOR.		LENGTHS LAID OUT.				Per- cent- age.		
	1894-95.		1896.		Total.				
	Feet.	Miles.	Feet.	Miles.	Feet.	Miles.			
Barnstable, . . .	292,315	55.36	44,340	8.40	18,534	3.51	62,874	11.91	21.51
Berkshire, . . .	308,564	58.44	40,834	7.64	19,184	3.63	59,518	11.27	19.30
Bristol, . . .	456,114	86.38	46,075	8.73	14,101	2.67	60,176	11.40	13.19
Dukes, . . .	112,716	21.35	26,042	4.93	9,890	1.87	35,932	6.80	31.85
Essex, . . .	398,127	75.40	24,495	4.64	19,093	3.62	43,588	8.26	10.96
Franklin, . . .	195,433	37.01	30,469	5.77	4,855	.92	35,324	6.69	18.08
Hampden, . . .	371,457	70.35	34,378	6.51	14,949	2.83	49,327	9.34	13.28
Hampshire, . . .	257,586	48.78	33,551	6.35	8,716	1.65	42,267	8.00	16.42
Middlesex, . . .	573,267	108.57	29,762	5.63	19,814	3.76	49,576	9.39	8.65
Nantucket, . . .	34,185	6.50	13,560	2.58	6,070	1.15	19,630	3.73	57.38
Norfolk, . . .	277,759	52.61	33,950	6.43	9,403	1.78	43,353	8.21	15.61
Plymouth, . . .	592,863	112.28	58,400	11.06	19,972	3.61	77,472	14.67	13.06
Suffolk, . . .	35,575	6.73	-	-	-	-	-	-	-
Worcester, . . .	842,532	159.57	55,100	10.43	31,800	6.02	86,900	16.45	10.31
Totals, . . .	4,748,493	899.33	470,456	89.10	195,481	37.02	665,937	126.12	14.13

Laid out on county petitions, 213,320 feet (40.40 miles).

Laid out on town petitions, 427,536 feet (80.97 miles).

Laid out on city petitions, 25,081 feet (4.75 miles).

Average length petitioned for, 15,467 feet (2.93 miles).

Average length laid out, 3,784 feet (.71 mile).

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